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CATECHISM SERIES

Operative Surgery

COMPLETE VOLUME

By

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OPERATIVE SURGERY.

ARTERIES.

LIGATURES OF THE UPPER EXTREMITY.

AXILLARY.

EXTENT.—From the lateral border of the first rib to the lower border of the teres major.

LINE.—From the middle of the clavicle to the centre of the antecubital fossa.

SITES OF LIGATURE.—First and third parts.

INDICATIONS.—(a) Wounds of the artery.
(b) Hæmorrhage below the artery.
(c) Aneurysm of the subclavian artery.
(d) Aneurysm of the third part of the axillary or of the brachial artery.

Describe Ligature of the First Part.

A longitudinal or a transverse incision will give sufficient access ; we shall describe the latter. Pull up the skin over the clavicle and make a transverse incision three inches long on the middle of the clavicle.

STEPS. (i) Make the incision with the patient's shoulder pushed upwards, and his arm abducted to a right angle. Divide skin, superficial fascia, platysma myoides, a few descending twigs of the cervical plexus, and the deep fascia.
Avoid the cephalic vein.

(ii) Divide the clavicular head of the pectoralis major, securing several large muscular arteries. Now **adduct the arm.**

- (iii) Incise or tear through the costo-coracoid membrane, avoiding the structures piercing the membrane.
- (iv) Displace the pectoralis minor downwards.
- (v) Pick up the axillary sheath, pull the axillary vein medially, and clear the artery from the brachial plexus.
- (vi) Pass the needle from the medial to the lateral side,—**be careful not to injure the nerve of Bell**, which lies posterior to the artery. Use silk or kangaroo tendon for the ligature.

The longitudinal incision is recommended by Kocher. It begins at the junction of the lateral and middle thirds of the clavicle, crosses the coracoid process, and descends in the sulcus between the deltoid and pectoralis major.

What is the Collateral Circulation?

The artery is usually tied above the thoracic axis; the main channels are (a) supra-scapular and posterior scapular + subscapular, (b) superior intercostal, aortic intercostals and internal mammary intercostals + thoracic branches of axillary.

Describe Ligature of the Third Part.

Make a three-inch incision along the medial border of the coraco-brachialis muscle.

STEPS. (i) Divide skin, superficial fascia, and deep fascia, the arm being abducted and rotated laterally.

(ii) Pull up the pectoralis major.

(iii) Identify the medial edge of the coraco-brachialis —**the superficial guide**; draw the muscle laterally.

(iv) Two nerves will now be observed lying in front of the artery, namely, the medial cutaneous and the medial head of the median; the latter forms **the deep guide**. Gently displace the medial cutaneous to the medial side and the median to the lateral side.

(v) Pass the needle as in ligature of the first part. **Avoid the musculo-spiral nerve**, which lies behind the artery.

Give the Collateral Circulation.

When tied *above* the subscapular branch, the anastomosis occurs between the supra-scapular, posterior scapular, and dorsalis scapulæ; if tied *below* the subscapular, by the subscapular and posterior circumflex anastomosing with the superior profunda.

BRACHIAL.

EXTENT.—From the lower border of the teres major to the neck of the radius.

LINE.—See axillary artery.

SITES OF LIGATURE.—A. In the centre of the upper arm.

B. In the antecubital fossa.

INDICATIONS.—(a) Local hæmorrhage.
(b) Palmar hæmorrhage.
(c) Traumatic aneurysm.

Describe Ligature in the Upper Arm.

Make a two-inch incision along the medial edge of the biceps, in the middle of the upper arm.

STEPS. (i) Divide the skin, superficial fascia, and deep fascia, the arm being abducted and extended, but **not resting upon the table**. Avoid the basilic vein in the incision.

(ii) Define the medial edge of the biceps—**the superficial guide**; pull the muscle laterally.

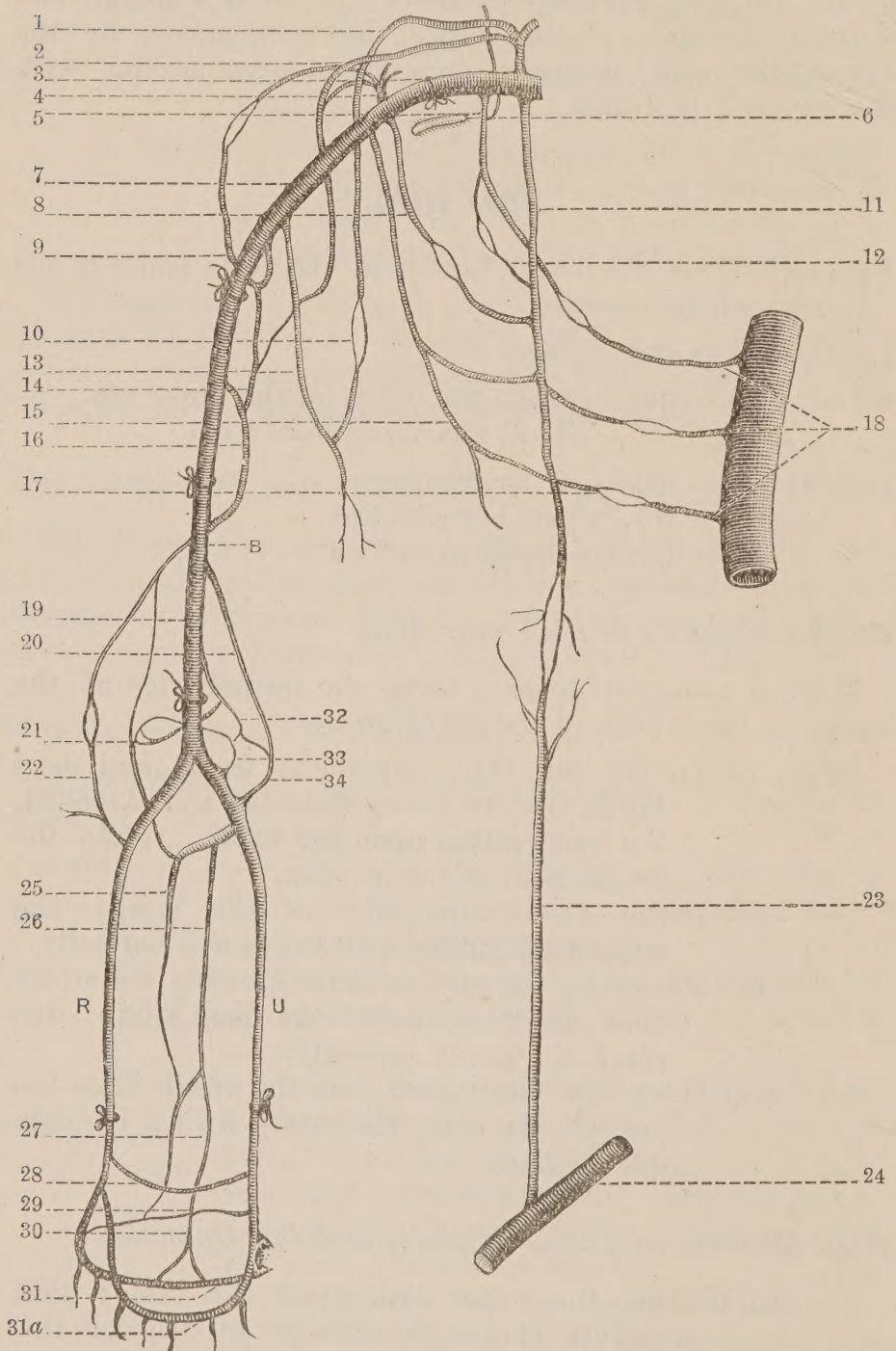
(iii) Recognise the median nerve crossing the artery from the lateral side—**the deep guide**; displace the nerve medially.

(iv) Open the sheath, and pass the needle from the medial side. Tie the artery with a chromic gut ligature.

What Mistakes may occur in performing this Operation?

(a) Resting the upper arm upon the table; this procedure causes the triceps to displace the biceps.

Fig 1.—COLLATERAL CIRCULATION OF THE UPPER EXTREMITY
(After SMITH and WALSHAM),



- (b) The median nerve may pass behind the artery, and be mistaken for the latter.
- (c) A high bifurcation of the brachial is often present, and one of the arteries may escape recognition.
- (d) The basilic vein may be tied instead of the artery.
- (e) A large superior profunda has been ligated in place of the main trunk.

Give the Collateral Circulation.

The site of ligature is either between the superior and inferior profunda arteries, or immediately below the latter. They anastomose with the recurrent branches of the ulnar, radial, and posterior interosseous; and also with the anastomotica branch of the brachial.

Describe Ligature in the Antecubital Fossa.

The arm is now supported upon the table and kept fully extended.

Make a two-inch incision along the medial bicipital sulcus, parallel to the median-basilic vein.

Explanation of Fig. 1.

B Brachial artery. *R* Radial artery. *U* Ulnar artery.

1. Posterior scapular artery. 2. Supra-scapular artery. 3. Subclavian artery. 4. Thoracic axis artery. 5. Superior intercostal artery. 6. First rib. 7. Axillary artery. 8. Superior thoracic branch. 9. Posterior circumflex artery, anastomosing with thoracic axis. 10. Anastomosis between posterior scapular and dorsalis scapulæ. 11. Internal mammary. 12. Anastomosis between internal mammary and superior intercostal. 13. Subscapular artery. 14. Anastomosis between superior profunda and posterior circumflex. 15. Long thoracic. 16. Superior profunda. 17. Anastomosis between long thoracic, internal mammary, and aortic intercostals. 18. Aortic intercostals. 19. Brachial artery (*B*). 20. Inferior profunda. 21. Interosseous recurrent. 22. Radial recurrent. 23. Deep epigastric. 24. External iliac. 25. Posterior interosseous. 26. Anterior interosseous. 27. Terminal branches of anterior interosseous. 28. Anterior carpal arch. 29. Posterior carpal arch. 30. Recurrent branches. 31. Deep palmar arch. 31A. Superficial palmar arch. 32. Anastomotica branch. 33. Anterior ulnar recurrent. 34. Posterior ulnar recurrent.

- STEPS. (i) Divide the skin and fascia, avoiding the median-basilic vein, and the anterior division of the medial cutaneous nerve.
- (ii) Divide the bicipital fascia; now **flex the elbow** and note three structures resting upon the brachialis anticus; they are from the lateral to the medial side—biceps tendon, brachial artery, and median nerve.
- (iii) Gently draw the median nerve medially, open the sheath of the artery, and pass the needle from the medial side. Tie the artery with chromic gut.

What is the Collateral Circulation?

The superior profunda, inferior profunda, and anastomotica magna + the recurrent branches of the ulnar, radial, and posterior interosseous.

ULNAR.

EXTENT.—From the neck of the radius, over the anterior annular ligament to form the superficial palmar arch.

LINE.—The lower two-thirds of the artery corresponds to a line joining the medial epicondyle to the lateral edge of the pisiform.

SITES OF LIGATURE.—*A.* Middle third of forearm.
B. Lower third of forearm.

INDICATIONS.—(a) Local hæmorrhage.
 (b) Traumatic aneurysm.

Describe Ligature of the Ulnar.

In each case an incision two inches long is made on the line of the artery.

- STEPS. (i) Divide the skin and fascia, and identify the septum between the flexor carpi ulnaris and the flexor sublimis digitorum. Now **flex the wrist**.
- (ii) Identify the artery resting upon the flexor profundus digitorum; the ulnar nerve is

closely related to the medial side of the artery. Pass the needle towards the lateral side, tying the vessel with chromic gut.

RADIAL.

EXTENT.—In the forearm, the artery extends from the neck of the radius to the styloid process of that bone.

LINE.—From the centre of the antecubital fossa to a point just medial to the radial styloid.

SITES OF LIGATURE.—*A.* Upper third of forearm.
B. Middle third of forearm.
C. Lower third of forearm.

INDICATIONS.—(*a*) Local hæmorrhage.
 (*b*) Traumatic aneurysm.

Describe Ligature of the Upper Third.

Make an incision two inches long in the line of the artery.

- STEPS. (i) Divide the skin and fasciæ, and identify the interval between the supinator longus (brachio-radialis) and the pronator radii teres ; separate these muscles.
- (ii) Clear the artery, and pass the needle from either side. The radial nerve is not an immediate relation.

Describe Ligature of the Middle Third.

Make an incision two inches long in the line of the artery.

- STEPS. (i) Divide the skin and fasciæ, and seek the space between the supinator longus (brachio-radialis), and the flexor carpi radialis ; separate these muscles.
- (ii) Clear the artery, and pass the needle from the radial side, as the radial nerve is in close contact with the lateral aspect of the vessel.

Describe Ligature of the Lower Third.

Make an incision two inches long in the line of the artery.

STEPS.—These are similar to ligature of the middle third.
The needle can be passed from either side, as the nerve has left the artery. Tie the radial artery with chromic gut.

LIGATURES OF THE LOWER EXTREMITY.

FEMORAL.

EXTENT.—From Poupart's (inguinal) ligament to the opening in the adductor magnus.

LINE.—From a point midway between the anterior superior iliac spine and the symphysis pubis, to the adductor tubercle. The limb should be abducted, rotated laterally, and flexed at the hip.

SITES OF LIGATURE.—

(A) Common Femoral.

(B) Superficial Femoral { (a) At apex of Scarpa's triangle.
(b) In Hunter's canal.

INDICATIONS.—(a) Local hæmorrhage.

(b) Plantar hæmorrhage.

(c) The common femoral is tied previous to amputation at the hip, by the anterior racquet method.

(d) Inguinal aneurysm.

(e) The superficial femoral can be ligated for popliteal aneurysm.

Describe Ligature of the Common Femoral,

This operation is rarely performed for aneurysm, as the resulting collateral circulation is feeble. Make an incision two and a half inches long, and half an inch below Poupart's (inguinal) ligament. The incision is parallel with the ligament, and has its centre over the artery.

STEPS. (i) Divide skin, superficial fascia, superficial vessels, and displace lymphatic glands.

- (ii) Divide the fascia lata, and recognise the anterior wall of the femoral sheath (fascia transversalis).
- (iii) Open the lateral compartment of the femoral sheath, and pull aside the femoral branch of the genito-femoral nerve.
- (iv) Open the special sheath, and pass the needle from the medial to the lateral side in order to avoid the femoral vein. Use silk or kangaroo tendon for the ligature.

Give the Collateral Circulation.

The main channels are: (a) Obturator + medial circumflex; (b) glutæal and sciatic + circumflex arteries and the first perforating; (c) internal pudic (pudendal) + external pudic (pudendal).

Describe Ligature of the Superficial Femoral.

This is termed the “*Seat of Election.*” Make an incision three inches long in the line of the artery, commencing a hand’s breadth below Poupart’s (inguinal) ligament.

- STEPS. (i) Divide skin, superficial fascia, superficial veins, but avoiding the main trunk of the long saphena vein. Divide the fascia lata.
- (ii) Recognise the medial edge of the sartorius.
Displace the muscle laterally.
- (iii) The artery will be found resting upon the adductor longus, the vein being postero-medial to the artery.
- (iv) Clear the artery and open the sheath. Pass the needle from the vein. Tie with silk.

What is the Collateral Circulation?

The chief routes are:—(a) descending branch of lateral circumflex + upper articular branches of popliteal, and anastomotica magna; (b) medial circumflex + muscular branches and anastomotica magna; (c) sciatic, circumflexes, perforating twigs + upper muscular branches of popliteal.

Describe Ligature in Hunter's Canal.

Make an incision four inches long on the line of the artery in the middle of the thigh.

- STEPS. (i) Divide skin and superficial fascia; hold the long saphena vein out of the way.
 (ii) Divide the fascia lata, and seek the lateral border of the sartorius; **displace the muscle medially.**
 (iii) Cut the aponeurotic roof of the canal; the artery is found between the vastus medialis and the adductors longus and magnus. The vein lies postero-lateral to the artery.
 (iv) Draw the long saphenous nerve to the lateral side. Open the sheath, and pass the needle from the vein. Tie the artery with silk.

The collateral circulation is identical with that after ligature of the femoral at the apex of Scarpa's triangle.

POPLITEAL.

EXTENT.—From the opening in the adductor magnus to the lower border of the popliteus.

LINE.—From the lateral edge of the semimembranosus down, midway between the two condyles, to a point opposite the tubercle of the tibia.

SITES OF LIGATURE.—(A) Upper third.
 (B) Lower third.

INDICATIONS.—(a) Local hæmorrhage.
 (b) Aneurysm.

Describe Ligature of the Upper Third.

This operation may be carried out either from the medial side of the thigh, or by an incision in the popliteal space; we shall undertake the former method.

Make an incision four inches long in the lower part of the femoral line.

- STEPS. (i) Divide skin and fasciæ, avoiding the long saphenous nerve and vein.

Fig. 2—LIGATURE OF THE ARTERIES OF THE LOWER EXTREMITY.



The letters *a, b, c, etc.*, indicate the points at which the arteries are accessible for ligature.

- (ii) Divide the fascia lata, thus exposing the sartorius and the semimembranosus. Retract the muscles backwards.
- (iii) Identify the tendon of the adductor magnus with the anastomotica magna artery lying upon it. Pull the tendon forwards, and carefully dissect in the fat of the popliteal space. The artery will be found resting upon the femoral trigone, with the vein and the internal popliteal (tibial) nerve on its lateral side.
- (iv) Pass the needle from the accompanying vein and popliteal nerve, using silk as the ligature material.

Describe Ligature of the Lower Third.

The patient is placed face downwards, and the knee-joint extended.

The incision commences in the middle of the popliteal space, and is four inches long on the line of the artery.

STEPS. (i) Divide the skin and fasciæ, avoiding the small sciatic nerve and the short saphenous vein.

(ii) Separate the two heads of the gastrocnemius, first **slightly flexing the knee**.

(iii) The artery is found resting upon the fascia of the popliteus, with the vein and internal popliteal (tibial) nerve on its medial side.

(iv) Pass the needle from the vein, using silk as before.

What is the Collateral Circulation?

A very free anastomosis occurs between the inferior articular branches, superior articular branches, anastomotica magna, and anterior tibial recurrent.

ANTERIOR TIBIAL.

EXTENT.—From the lower border of the popliteus to the anterior annular ligament where it becomes the dorsalis pedis.

LINE.—From a point midway between the lateral tuberosity of the tibia and the head of the fibula, to the mid-point between the malleoli.

SITES OF LIGATURE.—(A) Upper third of leg.
 (B) Middle third of leg.
 (C) Lower third of leg.

Describe Ligature of the Upper Third.

The incision is four inches long on the line of the artery.

- STEPS.** (i) Divide the skin and fasciæ.
 (ii) Seek the interval between the tibialis anticus and the extensor longus digitorum. **Stick to the lateral edge of the tibialis anticus.**
 (iii) Flex the ankle-joint, and separate the two muscles. The artery will be found on the interosseous membrane with the nerve lateral to it.
 (iv) Pass the needle from the nerve, tying the artery with chromic gut.

Describe Ligature of the Middle Third.

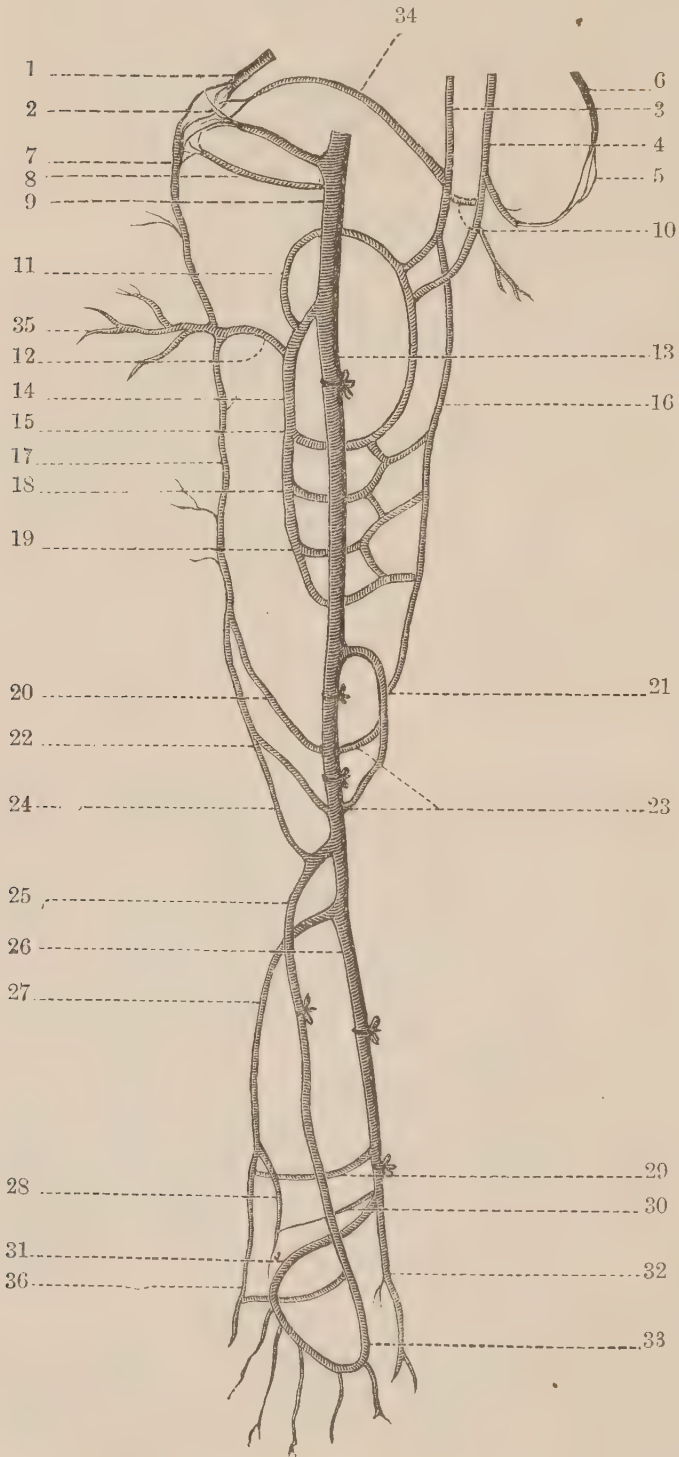
Make an incision three inches long on the line of the artery.

- STEPS.** (i) Divide the skin and fasciæ.
 (ii) Open up the interval between the tibialis anticus and the extensor longus digitorum.
 (iii) Now seek the space between the tibialis anticus and the extensor longus hallucis. **(Again stick to the lateral edge of the tibialis anticus.)**
 (iv) Flex the ankle-joint and expose the artery on the interosseous membrane; the nerve lies superficial to the artery. Displace the nerve to the lateral side, and pass the needle from the nerve. Use chromic gut.

Describe Ligature of the Lower Third.

The incision is two and a half inches long on the line of the artery.

Fig. 3.—COLLATERAL CIRCULATION OF THE LOWER EXTREMITY
(After SMITH and WALSHAM).



- Steps. (i) Divide the skin and fasciæ.
 (ii) Identify the tibialis anticus and the extensor longus hallucis. The artery is between them, resting upon the tibia, the nerve lying lateral to the artery. Pass the needle from the lateral to the medial side, and tie the vessel with chromic gut.

Describe Ligature of the Dorsalis Pedis.

Make an incision, one and a half inches in length, along a line from the middle of the ankle to the first metatarsal space.

- STEPS. (i) Divide the skin and fasciæ.
 (ii) Hook aside the medial tendon of the extensor brevis digitorum. The anterior tibial nerve is on the lateral side, therefore pass the needle from the nerve. Use chromic gut.

POSTERIOR TIBIAL.

EXTENT,—From the lower border of the popliteus to the medial annular ligament.

Explanation of Fig. 3.

1. Glutæal artery. 2. Anastomoses between glutæal, sciatic, lateral circumflex, deep circumflex iliac, and superficial circumflex iliac arteries. 3. Sciatic artery. 4. Obturator artery. 5. Anastomosis between pubic branches of deep epigastric and obturator arteries. 6. Pubic branch of deep epigastric. 7. Ascending branch of lateral circumflex. 8. Superficial circumflex iliac. 9. Common femoral. 10. Anastomosis between obturator and sciatic arteries. 11. Medial circumflex artery. 12. Lateral circumflex artery. 13. Superficial femoral. 14. Deep femoral (*profunda*). 15. First perforating. 16. Comes nervi ischiadici. 17. Descending branch of lateral circumflex. 18. Second perforating. 19. Third perforating. 20. Superior lateral articular. 21. Anastomotica magna. 22. Inferior lateral articular. 23. Superior and inferior medial articular arteries. 24. Anterior tibial recurrent. 25. Anterior tibial. 26. Posterior tibial. 27. Peroneal. 28. Anterior peroneal. 29. Communicating branch between peroneal and posterior tibial. 30. Malleolar branches. 31. Lateral plantar artery. 32. Medial plantar artery. 33. Dorsalis pedis. 34. Branch of sciatic artery. 35. Transverse branch of lateral circumflex. 36. Anastomosis behind lateral malleolus.

LINE.—From the bifurcation of the popliteal to a point midway between the medial malleolus and the corresponding border of the tendo Achillis.

SITES OF LIGATURE. —(A) Middle third of leg.
 (B) Lower third of leg.
 (C) At ankle.

Describe Ligature in the Middle Third.

The knee should be flexed, the foot extended, and the leg rest on its lateral side.

Make an incision four inches long, parallel with, and half-inch behind the medial border of the tibia.

- STEPS. (i) Divide skin and fasciæ. **Avoid the long saphena vein.**
 (ii) Draw backwards the edge of the gastrocnemius.
 (iii) Divide the tibial portion of the soleus, first the muscular then the tendinous fibres.
 (iv) Open the special fascia covering the deep muscles. The artery lies on the tibialis posticus with the nerve lateral to it.
 (v) Pass the needle from the nerve, using chromic gut.

Describe Ligature in the Lower Third.

The limb should be placed in the position mentioned for the middle third. The incision is three inches long on the line of the artery.

- STEPS. (i) Divide skin and fasciæ.
 (ii) Identify the flexor longus digitorum after dividing the special fascia covering the deep flexors. The artery lies upon this muscle; the nerve is lateral to the artery.
 (iii) Pass the needle from the nerve making use of chromic gut as before.

How is the Artery Ligated at the Ankle?

Place the limb in the attitude described above; make an incision two inches long, half-inch behind the edge of the medial malleolus, and following its curve.

- STEPS. (i) Divide skin and fasciæ.
 (ii) Cut the medial annular ligament, and origin of the abductor hallucis.
 (iii) Recognise the tendons of the flexor longus digitorum and flexor longus hallucis; the artery will be found between them, with the two plantar nerves on its lateral side; **don't open the tendon sheaths.**
 (iv) Pass the needle from the plantar nerves. Tie with chromic gut.

LIGATURES OF THE HEAD AND NECK.

COMMON CAROTID.

EXTENT.—In the head and neck, from the sterno-clavicular articulation to the upper border of the thyreoid cartilage.

LINE.—From the sterno-clavicular joint to a point midway between the angle of the jaw and the apex of the mastoid process.

SITES OF LIGATURE.—(a) Above the omo-hyoid.
 (b) Below the omo-hyoid.

The latter is very rarely undertaken.

INDICATIONS.—(a) Aneurysm of the common carotid.
 (b) Pulsating tumours of the orbit.
 (c) Chronic hydrocephalus. The artery is tied on one side, and ten days later the other artery is ligated.
 (d) Cirroid aneurysm.
 (e) Wounds of the vessel.

Describe Ligature above the Omo-hyoid.

The incision is three inches long on the anterior border of the sterno-mastoid, the centre being opposite the cricoid cartilage. The patient's head should be turned towards the opposite side.

STEPS. (i) Divide skin, superficial fascia, platysma, and deep fascia, tying the anterior jugular vein

as it lies between the platysma and deep fascia.

- (ii) Retract the sterno-mastoid, and secure the sterno-mastoid artery.
- (iii) Define the anterior belly of the omo-hyoid.
- (iv) Look for the descendens hypoglossi in the angle between the sterno-mastoid and the omo-hyoid, and hook the nerve to the lateral side.
- (v) Open the carotid sheath at its medial part.
- (vi) Open the special compartment for the artery, and pass the needle from the vein. **Avoid the pneumogastric nerve.** Tie the artery with silk or kangaroo tendon.

Describe Ligature below the Omo-hyoid.

Make an oblique incision running downwards and medially, one inch above the sterno-clavicular joint.

- STEPS. (i) Divide the superficial structures and secure the anterior jugular vein.
- (ii) Displace the sterno-mastoid backwards, and the sterno-hyoid and sterno-thyreoid medially.
 - (iii) Hook up or divide the omo-hyoid.
 - (iv) Open the carotid sheath and ligate the artery as in the previous method.

What is the Collateral Circulation ?

The main channels are—(a) superficial cervical, deep cervical + princeps cervicis from the occipital ; (b) branches of the external carotid + those of the opposite side ; (c) occipital + vertebral ; (d) vertebrals + internal carotid of the opposite side in the “circle of Willis” ; (e) superior thyreoid + inferior thyreoid ; (f) facial and superficial temporal + nasal and supra-orbital.

EXTERNAL CAROTID.

EXTENT.—From the upper border of the thyreoid cartilage to the neck of the condyle of the lower jaw.

LINE.—See common carotid.

SITE OF LIGATURE.—Opposite the hyoid bone.

- INDICATIONS.**—(a) Preparatory to extensive operations on the face, jaws, or tongue.
 (b) Cirroid aneurysm (this is not a good method of treatment, however.)
 (c) Malignant disease of the tonsil.
 (d) Wounds of the main trunk or any of its branches.

Describe Ligature of the External Carotid.

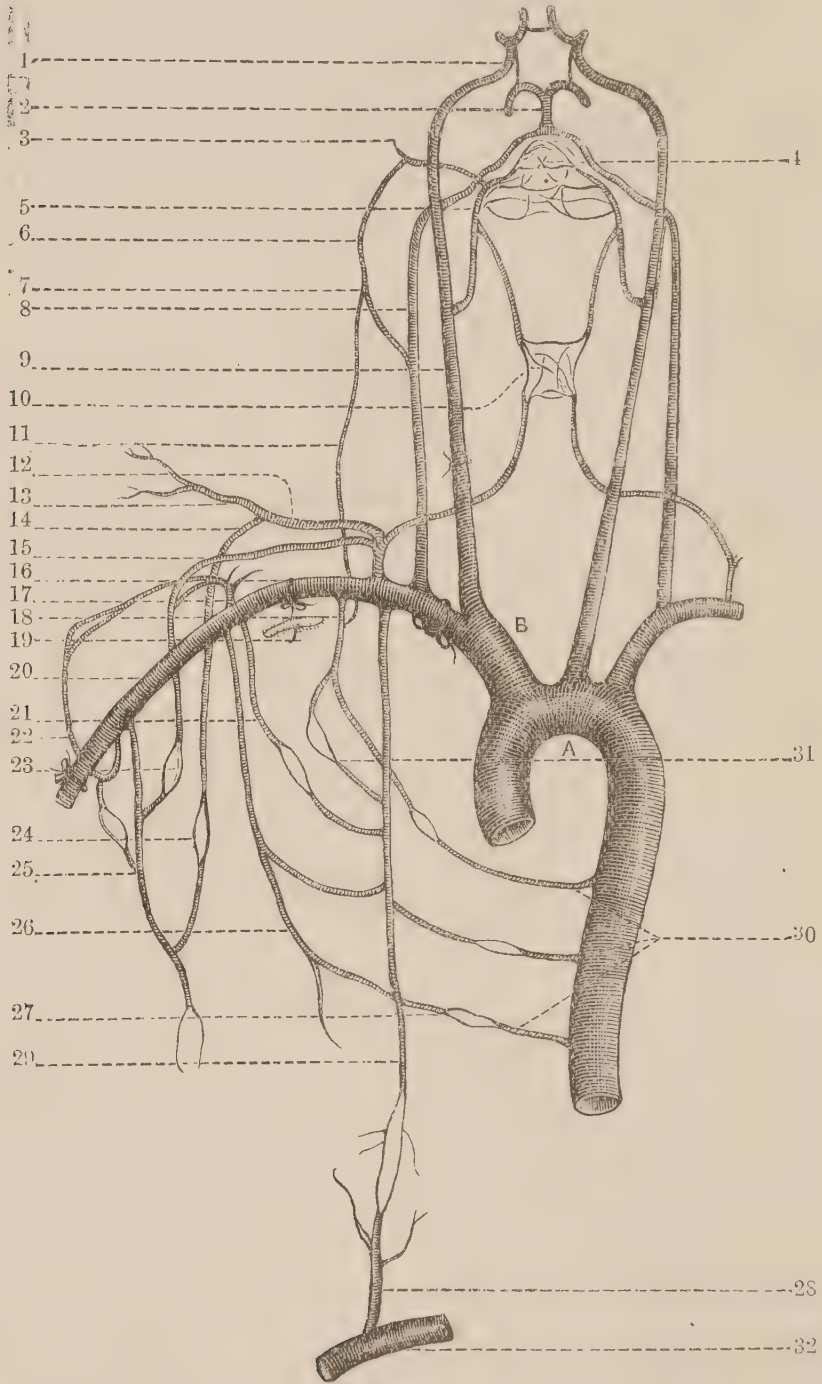
Make a three-inch incision on the line of the artery, the centre of the incision being opposite the great cornu of the hyoid. The patient's head and neck are placed in the position mentioned under ligature of the common carotid.

- STEPS.** (i) Divide the skin, superficial fascia, platysma, and deep fascia, avoiding the external jugular vein.
 (ii) Retract the anterior border of the sterno-mastoid.
 (iii) Seek the posterior belly of the digastric and the stylo-hyoid. Pull the muscles upwards.
 (iv) Hook aside a plexus of veins formed by the superior thyreoid, ranine and facial.
 (v) **Look out for the hypoglossal nerve**; carefully draw it upwards.
 (vi) Open the arterial sheath, and pass the needle from the lateral to the medial side. Apply the ligature (silk or kangaroo tendon) between the superior thyreoid and lingual branches. Be careful not to injure the internal laryngeal nerve which crosses behind the artery at this level.

Give Kocher's Incision.

Take a point on the anterior edge of the sterno-mastoid, half an inch below the angle of the jaw. An oblique incision, two inches long, is made in the natural fold of the neck having this point as its centre.

Fig. 4.—COLLATERAL CIRCULATION OF THE HEAD AND NECK
(After SMITH and WALSHAM).



Explanation of Fig. 4.

A Aorta.

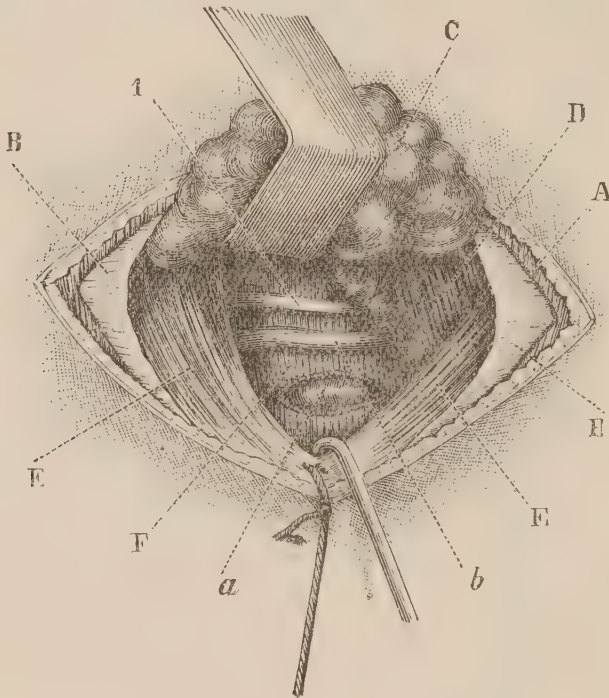
B Innominate Artery.

1. Circle of Willis, formed by the posterior cerebrals from the basilar, and the anterior cerebrals from the internal carotids, connected together by the anterior and posterior communicating branches.
2. Basilar artery, formed by the union of the two vertebrals.
3. Occipital artery, from the external carotid.
4. To represent the anastomoses between the corresponding branches of the two external carotids, viz. facial with facial, lingual with lingual, temporals with temporals, and occipital with occipital.
5. External carotid.
6. Princeps cervicis, from occipital.
7. Anastomoses between the princeps cervicis, vertebral, and profunda cervicis in the region of the suboccipital triangle.
8. Vertebral, from the subclavian.
9. Common carotid.
10. Anastomoses between the two superior and the two inferior thyreoids in the region of the thyreoid gland.
11. Profunda cervicis, from the superior intercostal.
12. Transversalis colli.
13. Its superficial cervical branch.
14. Posterior scapular artery, one of the divisions of the transversalis colli branch of the thyreoid axis; the other division is called the superficial cervical, and enters the trapezius.
15. Supra-scapular artery from the thyreoid axis, anastomosing with the sub-scapular from the axillary.
16. Subclavian artery.
17. Thoracic axis, from the axillary, anastomosing with the supra-scapular and posterior circumflex.
18. Superior intercostal, anastomosing with the internal mammary and the aortic intercostals.
19. The first rib.
20. Axillary artery.
21. Superior thoracic, anastomosing with the internal mammary.
22. Posterior circumflex, anastomosing with the thoracic axis and the subscapular.
23. Anastomosis between the supra-scapular and the subscapular.
24. Anastomosis between the posterior scapular and the subscapular.
25. Subscapular artery.
26. and 27. Long thoracic, anastomosing with the internal mammary and the aortic intercostals.
28. Deep epigastric, from the external iliac.
29. Internal mammary.
30. Aortic intercostals.
31. Anastomosis between the internal mammary and the superior intercostal.
32. External iliac.

What is the Collateral Circulation?

The chief vessels are—(a) branches of the external carotid + those of the opposite side; (b) occipital + vertebral; (c) superficial cervical, deep cervical + princeps cervicis from the occipital; (d) fascial and superficial temporal + nasal and supra-orbital.

Fig. 6.—LIGATURE OF RIGHT LINGUAL ARTERY.



- | | |
|------------------------|------------------------|
| A.—Platysma. | D.—Mylo-hyoid. |
| B.—Cervical fascia. | E.—Digastric. |
| C.—Submaxillary gland. | F.—Hyo-glossus. |
| (a) Lingual artery. | (b) Ranine vein. |
| | (1) Hypoglossal nerve. |
- (TREVES' *Operative Surgery*).

BRANCHES OF EXTERNAL CAROTID.

Ligature of the following branches will be described—(a) lingual, (b) facial, and (c) occipital. The former is undertaken for macroglossia, fungating epithelioma of the tongue, and in some cases, previous to removal of the tongue; the facial and occipital arteries are tied for hæmorrhage.

The lingual may be ligated in either its first part (between the external carotid and the posterior border of the hyo-

glossus), or its second part (under cover of the hyoglossus). The steps of the first operation are similar to those of ligature of the external carotid.

Describe Ligature of the Lingual in its Second Part.

Make a curved incision commencing half-an-inch below, and half-an-inch lateral to the symphysis menti, extending down to the hyoid bone, and then upwards to a point one inch below and one inch in front of the angle of the jaw.

STEPS. (i) Divide skin, superficial fascia, platysma, and deep fascia. **Avoid the facial vein.**

(ii) Pull the submaxillary gland upwards.

(iii) Identify the two bellies and the intermediate tendon of the digastric.

(iv) Examine the hyoglossus lying between the digastric bellies. On the hyoglossus note the hypoglossal nerve, and immediately below the nerve, the ranine vein.

(v) Very gently draw up the nerve and vein.

(vi) Divide the hyoglossus transversely, just above the hyoid bone, and the lingual artery will be seen. *In elderly subjects the hyoglossus is very thin, and unless great care be exercised the pharynx will be opened.*

Remember that ligature of the second part of the lingual does not cut off the dorsalis linguæ.

Describe Ligature of the Facial Artery.

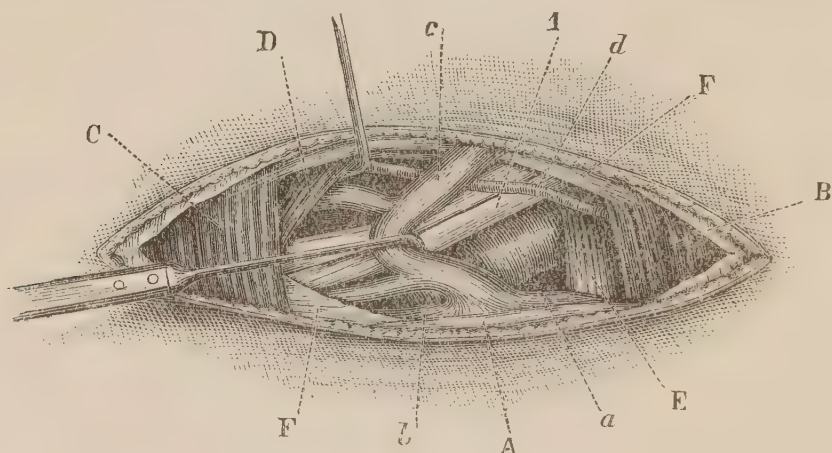
Make a transverse incision one inch long immediately below the spot where the artery crosses the inferior maxilla. Divide the superficial structures, and recognise the artery, with the facial vein posterior to it. Displace the vein backwards, and pass the needle from the vein.

How is the Occipital Artery ligated?

The second part of the artery can be reached by an incision two inches long, commencing at the apex of the mastoid process, and extending *towards* the external occipital protuberance.

- STEPS. (i) Divide the superficial coverings, avoiding the small occipital nerve.
- (ii) Divide the posterior part of the aponeurosis of the sterno-mastoid and pull the muscle forwards.
- (iii) Cut the splenius capitis and the trachelo-mastoid. The artery will be found on the complexus. Pass the needle from either direction.

Fig. 7.—LIGATURE OF RIGHT SUBCLAVIAN (Third Part).



A.—Clavicle.
B.—Sterno-mastoid.
C.—Trapezius.
D.—Omo-hyoid.
E.—Sclenus anticus.
F.—Cervical fascia.

(a) Subclavian artery.
(b) Subclavian vein.
(c) External jugular vein.
(d) Transverse cervical artery.
(l) Brachial plexus.

(TREVES' *Operative Surgery*).

THIRD PART OF SUBCLAVIAN.

EXTENT.—From the posterior border of the scalenus anticus to the lateral border of the first rib.

LINE.—The subclavian artery is represented by a curved line, with the convexity upwards, from the sterno-clavicular joint to the middle of the clavicle. The highest point of the curve reaches three-quarters of an inch above the clavicle.

INDICATIONS.—(a) Axillary aneurysm.
(b) Axillary or subclavian hæmorrhage.
(c) As a preliminary to Berger's inter-scapulo-thoracic amputation.

Describe Ligature of the Third Part of the Subclavian.

Support the shoulders with a pillow, turn the head towards the opposite side, and depress the shoulder of the side to be operated on. Pull the skin downwards over the clavicle, and make a three-inch incision on the middle third of the bone.

STEPS. (i) Divide the skin, superficial fascia, platysma, descending branches of cervical plexus, and deep fascia.

(ii) Identify the posterior border of the sternomastoid.

(iii) Seek for the posterior belly of the omo-hyoid. The transversalis colli vessels will be found crossing beneath the muscle. Hook up the muscle and the vessels.

(iv) Pull aside the external jugular vein and its tributaries.

(v) With blunt dissection expose the posterior border of the scalenus anticus, and trace it down to the **scalene tubercle** on the first rib. *When the tip of the finger is resting upon the scalene tubercle the artery will be found beneath the pulp of the finger.*

(vi) There are still two structures lying in front of the artery, namely the nerve to the subclavius and the supra - scapular artery. Gently displace them.

(vii) Open the sheath and pass the needle from above downwards, **to avoid the lowest trunk of the brachial plexus**. Tie the artery with kangaroo tendon. Care must be exercised or the pleura will be injured.

Give the Collateral Circulation.

This is similar to the collateral circulation following ligature of the first part of the axillary artery (*see* page 2).

VERTEBRAL.

This branch of the first part of the subclavian artery has been tied for (a) idiopathic epilepsy, and (b) basilar aneurysm

The right vessel is ligated, as the left one is closely applied to the thoracic duct.

Describe Ligature of the Vertebral.

Turn the head towards the left side, and make a three-inch incision along the anterior border of the sterno-mastoid commencing at the sterno-clavicular joint.

STEPS. (i) Divide the skin, superficial fascia, platysma, and deep fascia, pulling aside or tying the anterior jugular vein.

(ii) Retract the sterno-mastoid.

(iii) Draw the depressor muscles of the hyoid (*i.e.* omo-hyoid, sterno-hyoid, and sterno-thyreoid) downwards and medially.

(iv) The carotid sheath is now exposed; displace it to one side.

(v) Divide the prevertebral layer of cervical fascia, and seek the interval between the longus colli and the scalenus anticus. **Now identify the carotid tubercle.** The artery enters the costo-transverse foramen of the sixth cervical vertebra immediately below this tubercle. The vertebral vein lies in front of the artery.

(vi) Pull the vein towards the lateral side, and pass the needle from it. Owing to the damage of the sympathetic filaments accompanying the artery, the pupil on the corresponding side will be noticed to contract.

INNOMINATE.

EXTENT.—From the aortic arch to its bifurcation into right subclavian and common carotid.

LINE.—From a point a little to the right of the centre of the manubrium sterni to the right sterno-clavicular joint.

INDICATIONS.—(a) Aneurysm of the common carotid.
(b) Aneurysm of the subclavian.

Describe Ligature of the Innominate.

Make a vertical incision from the lower edge of the cricoid to one inch below the episternal notch. The patient's head should be thrown well backwards and kept perfectly steady.

- STEPS. (i) Divide skin, superficial fascia, platysma, and deep fascia, tying the transverse communicating branch of the anterior jugular veins.
- (ii) Separate the sterno-hyoids, and then the sterno-thyreoids.
- (iii) Divide the pretracheal layer of cervical fascia, secure the inferior thyroid veins, and hook upwards the isthmus of the thyroid body.
- (iv) In the lower part of the wound displace any remains of the thymus gland.
- (v) The artery will be found crossing the trachea and behind the manubrium sterni. Sometimes the manubrium has to be divided in order to conveniently reach the artery.
- (vi) Clear the artery, especially avoiding the innominate veins, the phrenic, and pneumogastric nerves, and the right pleural sac.
- (vii) Pass the needle from without medially using kangaroo tendon or a strip of ox aorta.

The right common carotid and vertebral arteries should be tied at the same operation.

ARTERIES OF THE THORAX AND ABDOMEN.

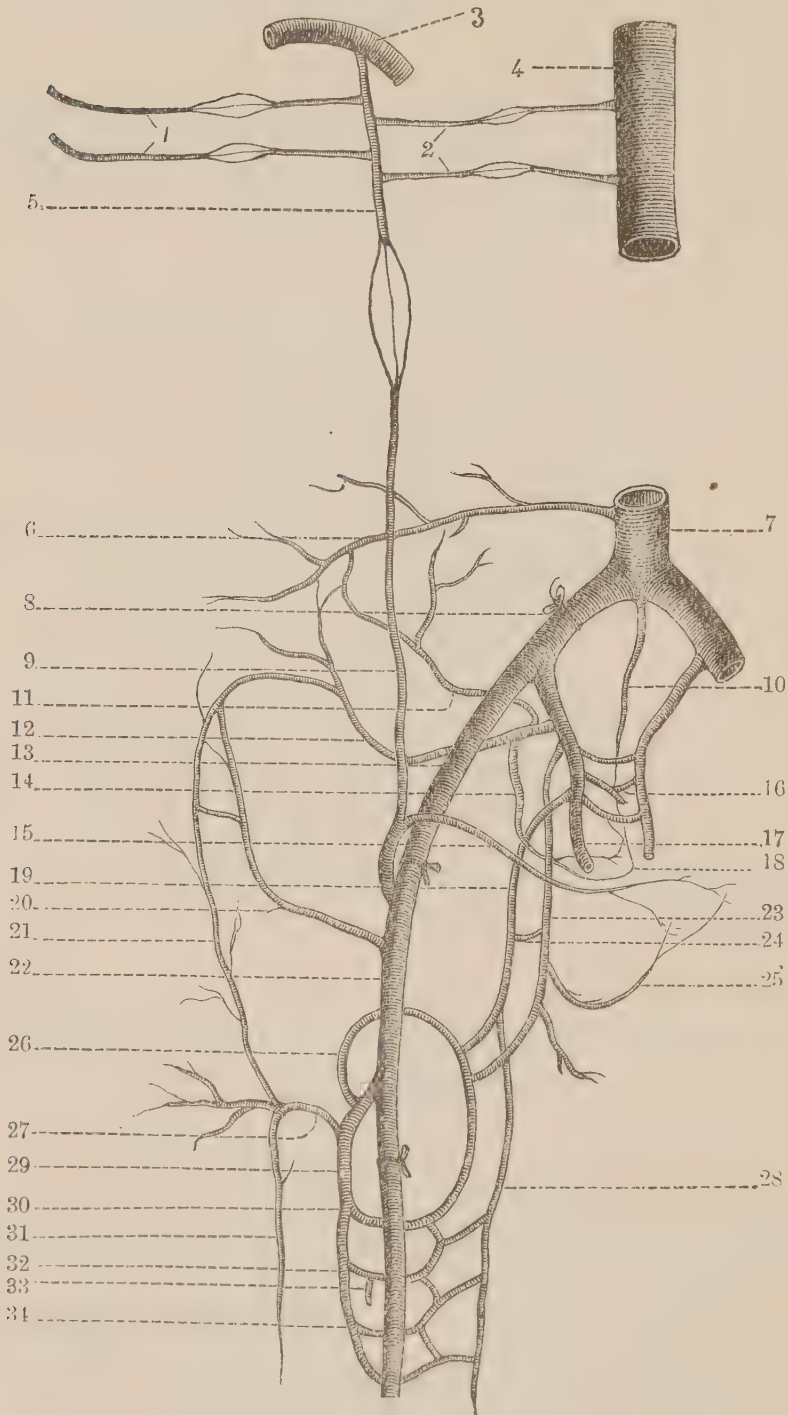
INTERNAL MAMMARY.

EXTENT.—From the sterno-clavicular joint to the sixth intercostal space.

LINE.—Half an inch from the lateral sternal margin.

INDICATION.—Hæmorrhage in anterior part of intercostal space.

FIG. 7.—COLLATERAL CIRCULATION OF THE ABDOMEN
(After SMITH and WALSHAM).



Describe Ligature of the Internal Mammary.

The second intercostal space is the "seat of election." Make a horizontal incision two inches long, commencing at the lateral sternal margin. The incision should lie in the middle of the space. Divide skin and fasciæ, pectoralis major, anterior intercostal membrane, and internal intercostal muscle. Pull aside the anterior intercostal nerve. The artery lies upon the pleura, and has venæ comites. Pass the needle from either side, using chromic gut as the ligature material.

COMMON ILIAC.

EXTENT.—From the left side of the body of the fourth lumbar vertebra to the lumbo-sacral articulation.

LINE.—The upper third of a line drawn from a point half an inch to the left, and three quarters of an inch below the umbilicus, to the mid-point between the anterior superior iliac spine and the symphysis pubis.

INDICATIONS.—(a) Aneurysm of either external or internal iliac.

(b) Hæmorrhage from any of the iliac arteries on the same side.

(c) Pelvic enchondroma.

Explanation of Fig. 7.

1. Thoracic branches of axillary. 2. Anastomosis between internal mammary and aortic intercostals. 3. Subclavian artery. 4. Aorta. 5. Internal mammary. 6. Last lumbar artery. 7. Aorta. 8. Common iliac. 9. Deep epigastric. 10. Middle sacral artery. 11. Iliolumbar artery. 12. Glutæal artery. 13. External iliac. 14. Lateral sacral. 15. Pubic branch of deep epigastric. 16. Anastomosis between visceral branches of internal iliacs. 17. Pudic artery. 18. Anastomosis between lateral and middle sacrals. 19. Sciatic artery. 20. Deep circumflex iliac. 21. Ascending branch of lateral circumflex. 22. Femoral artery. 23. Obturator artery. 24. Anastomosis between obturator and sciatic. 25. Pubic branch of obturator, anastomosing with pubic branch of deep epigastric. 26. Medial circumflex. 27. Lateral circumflex. 28. Comes nervi ischiadici. 29. Profunda artery. 30. First perforating. 31. Descending branch of lateral circumflex. 32. Second perforating. 33. Nutrient artery of femur. 34. Third perforating.

Describe Ligature of the Common Iliac.

With the patient in the Trendelenburg position make an incision in the linea alba from the umbilicus to the symphysis pubis. If, during the course of the operation, more room is required, it can be obtained by extending the incision upwards a little to one side of the umbilicus.

STEPS. (i) Divide skin, fasciæ, linea alba, fascia transversalis, and parietal peritoneum.

(ii) Draw the pelvic colon to the left and the small intestines to the right.

(iii) Incise the parietal peritoneum covering the artery for a distance of $1\frac{1}{2}$ inches.

(iv) Clear the artery, avoiding the **ureter**, the veins, sympathetic nerve fibres, and, on the left, the superior hæmorrhoidal vessels.

(v) Pass the needle from the vein, *i.e.* from right to left, using kangaroo tendon or silk.

Give the Collateral Circulation.

The main vessels are (a) deep (inferior) epigastric + superior epigastric and aortic intercostals; (b) deep circumflex iliac and ilio-lumbar + last lumbar branch of aorta; (c) visceral branches of internal iliac (hypogastric) + those of the opposite side.

INTERNAL ILIAC (HYPOGASTRIC.)

EXTENT.—From the lumbo-sacral articulation to the upper border of the great sacro-sciatic notch.

INDICATIONS.—(a) Aneurysm of any of its branches, especially the glutæal.

(b) Hæmorrhage from itself or any of its branches.

Describe Ligature of the Internal Iliac.

The position of the patient, the incision and the various steps necessary in order to expose the artery are similar to those of the common iliac. If the index finger be placed upon the lumbo-sacral promontory two cord-like ridges can

be identified. The lateral ones are formed by the common and external iliaes; the medial ones by the internal iliaes. **Avoid the ureter**, the vein, the sympathetic nerves and on the right side the external iliac vein. Pass the needle from within out. The ligature material is similar to that used for the common iliac.

What is the Collateral Circulation?

Numerous important branches carry on the circulation after ligature of the internal iliac. They are (a) lateral sacral + middle sacral, (b) superior hæmorrhoidal + middle and inferior hæmorrhoidals; (c) glutæal and sciatic + medial circumflex; (d) sciatic + medial and lateral circumflexes and first perforating; (e) deep epigastric + obturator; (f) internal pudic (pudendal) + external pudic; (g) ilio-lumbar + last lumbar branch of aorta, and deep circumflex iliac; (h) visceral branches of internal iliac + those of the opposite side.

EXTERNAL ILIAC.

EXTENT.—From the lumbo-sacral articulation to Poupart's (inguinal) ligament.

LINE.—The lower two-thirds of the iliac line (*see common iliac artery*).

INDICATIONS.—(a) Femoral aneurysm.
(b) Inguinal aneurysm.
(c) Wounds of the artery or its branches.

Describe Ligature of the External Iliac.

The artery can be tied by an incision through the linea semilunaris (the trans-peritoneal method), or by the extra-peritoneal operations of Cooper and Abernethy. Cooper's incision is $3\frac{1}{2}$ inches long. It commences 1 inch internal to the anterior superior iliac spine, runs $\frac{1}{2}$ inch above Poupart's ligament, and terminates $\frac{1}{2}$ inch short of the external (subcutaneous) abdominal ring.

STEPS. (i) Divide the skin and fasciæ, tying the superficial epigastric vessels.
(ii) Split the aponeurosis of the external oblique.

- (iii) Divide the internal oblique and transversalis muscles.
- (iv) Take two retractors—the inner one displaces the spermatic cord, and deep (inferior) epigastric vessels *upwards and inwards*; the outer retractor hooks the internal oblique and transversalis *upwards and outwards*.
- (v) Pick up and divide the fascia transversalis, thus exposing the parietal peritoneum. Carefully push aside the latter.
- (vi) Open the sheath of the artery about 1 inch above Poupart's ligament. **Avoid the deep circumflex iliac vein and the genito-femoral nerve.**
- (vii) Pass the needle from the external iliac vein, *i.e.* from the medial side; use kangaroo tendon.

Give the Steps of the Trans-peritoneal Operation.

An incision is made through the lateral margin of the sheath of the rectus.

- STEPS. (i) Divide the superficial structures and displace the rectus medially.
- (ii) Incise the fascia transversalis and the parietal peritoneum.
 - (iii) Place the patient in the Trendelenburg position and pack off the bowels.
 - (iv) In dealing with the right external iliac, cautiously divide the parietal peritoneum directly over the artery.
 - (v) On the left side, the pelvic meso-colon prevents direct access to the vessel, hence it is necessary to incise the parietal peritoneum near the middle line and strip it laterally.
 - (vi) Pass the needle as in the extra-peritoneal operation. Look out for the ureter.

Give the Collateral Circulation.

The chief routes are (a) deep (inferior) epigastric + superior epigastric; (b) deep circumflex iliac + ilio-lumbar and last

lumbar branch of aorta; (*c*) internal pudic (pudendal) + external pudic; (*d*) obturator + medial circumflex; (*e*) glutæal and sciatic + circumflexes.

OPERATIONS ON JOINTS.

TERMS USED IN OPERATIONS ON JOINTS.

ARTHROTOMY.—Opening a joint. This may be undertaken for purposes of drainage, or for the removal of diseased tissues or loose bodies.

ARTHRODESIS.—Ankylosing a joint. All the synovial membrane and articular cartilages are scraped out of the joint. The operation is frequently performed to stiffen the flail-like joints of infantile paralysis.

ARTHROLYSIS.—Restoring mobility to an ankylosed joint.

ARTHROPLASTY.—Murphy's operation. The joint is opened, the articular extremities of the bones removed, and a piece of fatty tissue placed between the ends of the bones. The subsequent movements of the joint convert the fat into synovial membrane.

ARTHRECTOMY.—This procedure is often termed "partial excision." It consists in opening the joint and scraping away the articular surfaces (*i.e.* cartilage and bone) with a gouge.

EXCISION.—Opening a joint, clearing away all synovial membrane and inter-articular ligaments, and sawing off the articular surfaces of the bones entering into the joint.

JOINTS OF THE UPPER EXTREMITY.

SHOULDER-JOINT.

| | |
|-------------|--|
| INDICATIONS | (<i>a</i>) Tubercular disease. |
| FOR | (<i>b</i>) Septic arthritis. |
| EXCISION. | (<i>c</i>) Unreduced dislocations. |
| | (<i>d</i>) Charcot's disease (rare in this joint). |
| | (<i>e</i>) Gun-shot wounds. |

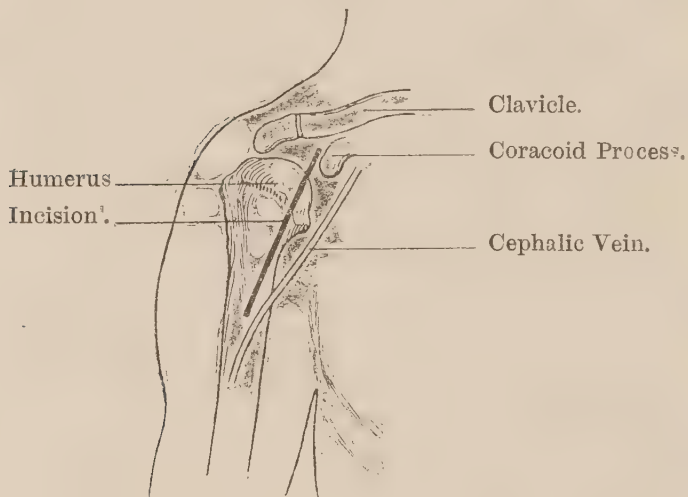
METHODS EMPLOYED.—The common operations are those of:
 A. The anterior method.
 B. Kocher.

Describe the Anterior Method.

A four-inch incision is made, commencing immediately above and lateral to the coracoid process; it passes downwards and slightly laterally between the deltoid and pectoralis major.

- STEPS. (i) Divide skin and fasciæ. Tie the humeral branch of the thoracic axis artery, but **avoid the cephalic vein**. A few of the anterior fibres of the deltoid will have been cut.

Fig. 8.—EXCISION OF SHOULDER.



Observe position of Cephalic Vein which roughly indicates the interval between the Deltoid and Pectoralis Major.

- (ii) Open up the interval between the deltoid and pectoralis major until the bicipital groove is seen. Tie the anterior circumflex artery.
- (iii) Divide the transverse humeral ligament, and hook aside the biceps tendon.
- (iv) The assistant rotates the arm medially, while the surgeon clears the supra-spinatus, infra-spinatus, and teres minor from the great tuberosity of the humerus. The muscles must be removed subperiosteally.
- (v) The arm is next rotated outwards, and the

subscapularis removed subperiosteally from the lesser tuberosity.

- (vi) Open up the capsule freely and protrude the head of the humerus.
- (vii) With a butcher's saw divide the bone through the anatomical neck. The glenoid cavity may require scraping with a sharp spoon.
- (viii) Remove all diseased synovial membrane. If operating for tubercular disease, rub iodoform emulsion into the joint.

In cases where drainage is required, a counter-opening at the back of the joint will be necessary.

Describe Kocher's Method.

Commence the incision at the acromio-clavicular-joint, carry it along the spine of the scapula for two and a half inches, then curve downwards and laterally, stopping one inch from the posterior fold of the axilla.

STEPS. (i) The incision divides skin and fasciæ, opens the acromio-clavicular joint, cuts the insertion of the trapezius along the upper border of the spine, and in its descending part, exposes the posterior edge of the deltoid.

(ii) Separate, subperiosteally, the posterior fibres of the deltoid until the acromion process is reached.

(iii) Drill two holes in the acromion and two in the adjacent portion of the spine, then chisel off the acromion. **Avoid the supra-scapular artery and nerve lying in the great scapular notch.** Push the acromion and deltoid forwards.

(iv) The assistant rotates the arm laterally, and pushes the head of the humerus upwards and backwards. Divide the capsule immediately behind the long tendon of the biceps, at the upper edge of the supra-spinatus.

(v) Detach the insertions of the supra-spinatus, infra-spinatus and teres minor from the great tuberosity, and draw the muscles backwards.

Separate the biceps tendon from its groove and pull it forwards.

- (vi) Treat the synovial membrane and bone as in the anterior method. Wire back the acromion process.

What is the After-Treatment ?

Abduct the arm upon a pillow. Massage and passive movements are carried out whenever the skin incision is healed. Active movements must be commenced early, starting with extension.

ELBOW-JOINT.

- INDICATIONS FOR EXCISION.
- (a) Tubercular disease.
 - (b) Bony ankylosis following disease or trauma.
 - (c) Compound and comminuted fractures.
 - (d) Unreduced dislocations.

METHODS EMPLOYED.—At the present day either

- A. The median posterior incision, or that of
- B. Kocher.

Describe the Median Posterior Method.

The arm to be operated on should be flexed at the elbow and allowed to rest upon the patient's chest. The incision is four inches long, the centre corresponding to the summit of the olecranon process. Instead of making the incision exactly in the middle line, some surgeons prefer to keep a little to the ulnar side.

STEPS. (i) Divide the skin, fasciæ, subcutaneous bursa, triceps muscle, subtendinous bursa, and posterior part of the capsule.

- (ii) Now extend the elbow, and with a knife and periosteal elevator clear the medial aspect of the joint, removing the triceps from the olecranon process, and the common origin of the flexor tendons from the medial epicondyle.
Be careful not to injure the ulnar nerve.

- (iii) From the lateral side of the joint clear the corresponding part of the triceps from the olecranon, and the common attachment of the extensors from the lateral epicondyle. Endeavour to preserve the fascia of the triceps which extends over the anconeus. **Avoid the posterior interosseous nerve.**

Fig. 20.—EXCISION OF ELBOW.



Observe the Ulnar Nerve passing behind the Medial Epicondyle.

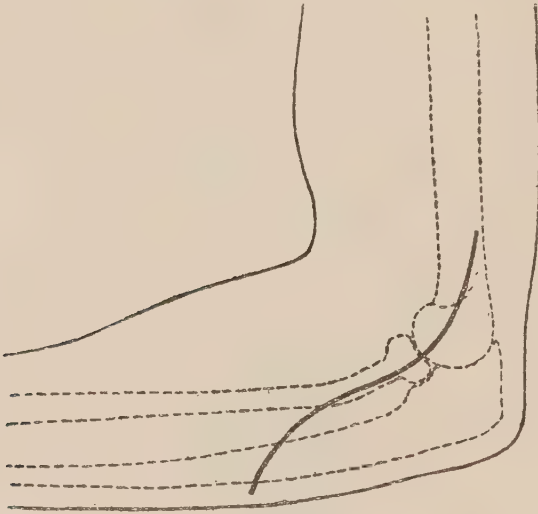
- (iv) Divide the collateral ligaments and flex the joint strongly. Protrude the bones of the forearm.
- (v) With a butcher's saw divide the upper end of the ulna, the section being in a line with the upper part of the coronoid process. Divide the radius at the same level.
- (vi) Now protrude the humerus and apply the saw immediately above the olecranon fossa.

- (vii) Remove all diseased synovial membrane, and taking a piece of fat from the back of the joint, interpose it between the ends of the bones. The subsequent movements of the joint convert the fat into synovial membrane.

Describe Kocher's Method.

The elbow is flexed to an angle of about 150° . The incision commences at the lateral supra-condyloid ridge, two inches above the lateral epicondyle, passes vertically down-

Fig. 10.—KOCHER'S INCISION FOR EXCISION OF THE ELBOW.



Shows outer aspect of Left Elbow-Joint.

wards to the head of the radius, then follows the lateral edge of the anconeus to a point on the posterior border of the ulna three inches below the tip of the olecranon, and lastly, curves inwards over the medial aspect of the ulna.

STEPS. (i) Divide skin and fasciæ. Then in the upper part of the incision, go down between the supinator longus (brachio-radialis) and extensor carpi radialis longior in front, and the triceps behind. In the lower part of the wound go between the extensor carpi ulnaris and the anconeus.

- (ii) Open the capsule and detach the triceps and anconeus subperiosteally. Pull them to the medial side.
- (iii) Detach the structures attached to the lateral epicondyle, and dislocate the forearm inwards.
- (iv) Separate the ulnar collateral ligament and muscles from the medial epicondyle.
- (v) The remaining steps are similar to those of the vertical method. Kocher saws the bones so as to leave the humerus convex, and the radius and ulna concave.

What is the After-Treatment?

Three different plans have been adopted regarding the position of the limb after operation. Some surgeons flex the limb to a little less than a right angle; others fix it in full extension; and lastly, many keep the elbow flexed during the night and extended during the day. Begin movements as early as possible.

WRIST-JOINT.

INDICATION FOR EXCISION.—The operation is only performed for tubercular disease in an advanced stage.

METHODS EMPLOYED.—*A.* Lister.

B. Kocher.

C. Dorsal-radial.

D. Heron-Watson.

Describe the Dorsal-radial Method.

N.B.—Before commencing the operation break down all adhesions in the fingers.

The incision is three and a half inches long. It commences on the radial side of the middle of the metacarpal bone of the index finger, passes to the base of the same bone, then over the radial tubercle, and vertically up the forearm. The first part of the incision is parallel to the extensor indicis, the second part crosses the tendon of the extensor longus (or secundi) pollicis, and the third part stops short of the extensor brevis (or primi) pollicis and extensor ossis metacarpi pollicis.

- STEPS. (i) Divide skin and fasciæ; tie radial veins, but endeavour to preserve branches of the radial nerve.
- (ii) Divide the posterior annular ligament. Hook the tendon of the extensor longus pollicis to the radial side, and the extensor communis digitorum and extensor indicis to the ulnar side.
- (iii) Detach, subperiosteally, the tendons of the extensor carpi radialis longior, extensor carpi radialis breviar and extensor carpi ulnaris from the bases of the second, third, and fifth metacarpals respectively.
- (iv) Divide the posterior ligament of the wrist, and separate it from the carpus.
- (v) Cut the collateral ligaments, and introduce the knife between the pisiform and cuneiform. The pisiform is thus preserved with the tendon of the flexor carpi ulnaris.
- (vi) Flex the wrist, divide the anterior annular ligament, and with bone forceps snip off the hook of the unciform, leaving it behind to protect the deep branch of the ulnar nerve. Hold the flexor tendons forward.
- (vii) Remove all the remaining carpal bones, if possible preserving the trapezium. **Avoid the radial artery lying on the lateral aspect of the wrist.**
- (viii) Saw off a thin section from the bases of the four inner metacarpals, and from the lower end of the radius and ulna.

What is the After-Treatment?

Fix the hand on an anterior splint in a position of dorsiflexion. The fingers should be perfectly free, and must be moved quite early or stiffness will result. Passive movement of the wrist commences whenever the skin incision is healed. Later, the hand should be supported in a sling in the semiprone position.

Describe Kocher's Method.

The hand is slightly flexed towards the radial side. The incision commences on the ulnar aspect of the centre of the fifth metacarpal bone, and extends upwards over the middle of the wrist and back of the forearm, for a distance of three and a half inches.

STEPS (i) Divide skin and fasciæ, **avoiding the dorsal branch of the ulnar nerve.**

(ii) Divide the posterior annular ligament, and pull the tendons of the extensor communis digitorum and extensor minimi digiti to the radial side.

(iii) Cut the posterior ligament of the carpus and separate it from the bones, at the same time detaching, subperiosteally, the tendon of the extensor carpi ulnaris.

(iv) Open the joint between the cuneiform and the pisiform, and pull the latter forward with the tendon of the flexor carpi ulnaris. Snip off the hook of the unciform, and lift the flexor tendons forward. The remaining steps are similar to those of the dorsal-radial method.

JOINTS OF THE LOWER EXTREMITY.

HIP-JOINT.

| | |
|-------------|-----------------------------|
| INDICATIONS | (a) Tubercular disease. |
| FOR | (b) Septic arthritis. |
| EXCISION. | (c) Unreduced dislocations. |
| | (d) Gun-shot wounds. |

METHODS EMPLOYED—A. The anterior method.

B. The posterior method (Kocher).

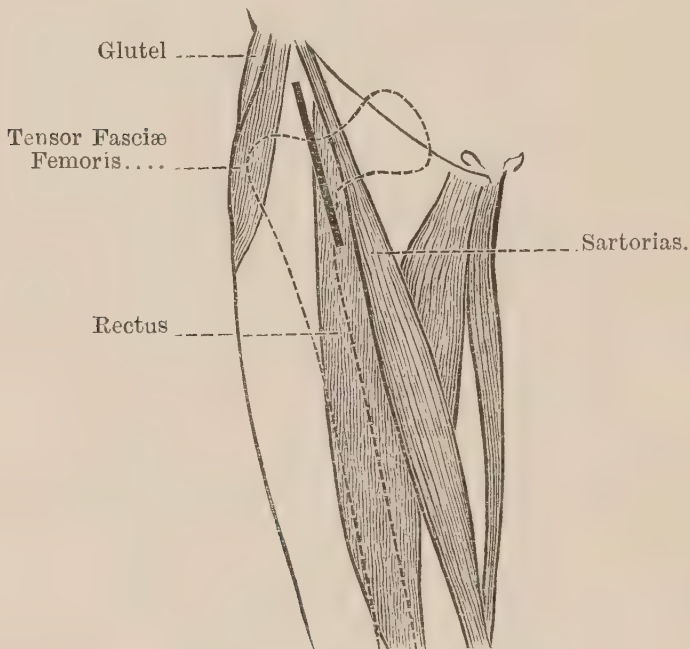
The anterior incision is very suitable for exposing the joint in congenital dislocation of the hip.

Describe the Anterior Method.

The incision commences half an inch below the anterior superior iliac spine, and runs downwards and medially for four inches.

- STEPS. (i) After division of the superficial structures, pass between the sartorius and the tensor fasciæ femoris, then between the rectus femoris and the glutæus medius and minimus. Tie the ascending branch of the lateral circumflex artery.
- (ii) Incise the capsule in a vertical direction.
- (iii) Divide the neck of the femur with a narrow-bladed saw.

Fig. 11.—EXCISION OF HIP BY ANTERIOR INCISION.



- (iv) Grasp the upper part of the neck with lion-forceps, divide the ligamentum teres and remove the head.
- (v) Examine the acetabulum, and if necessary, scrape it out with a sharp spoon.
- (vi) Remove all synovial membrane and diseased portions of the capsule.

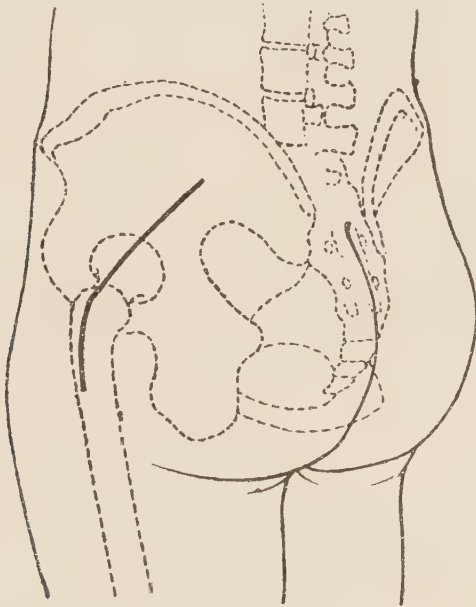
If drainage is necessary, a posterior opening should be made.

Describe Kocher's Method.

The patient lies on his healthy side with the diseased hip flexed. A curved incision is made about five inches long. It commences at the lower and lateral aspect of the great trochanter, is carried towards its anterior superior angle, and then obliquely upwards and backwards.

STEPS. (i) Divide skin and fasciæ, and pick up branches of the lateral circumflex artery.

Fig. 12.—KOCHER'S POSTERIOR INCISION FOR EXCISION OF THE HIP-JOINT.



- (ii) Divide the glutæus maximus upon the lateral aspect of the great trochanter. The upper and back part of the incision splits the glutæus maximus in the line of its fibres.
- (iii) Seek the interval between the glutæus medius and minimus above, and the piriformis below.
- (iv) Flex the hip and rotate laterally. Separate the glutæus medius and minimus, and the periosteum and ilio-femoral ligament from their attachment to the great trochanter and anterior intertrochanteric line respectively.

- (ii) Turn up the flap of the patella so as to reach the upper border of that bone. (*N.B.*—Some surgeons divide the ligamentum patellæ instead.)
- (iii) Divide the quadriceps extensor. Throw the patella downwards, and cut the tibial and fibular collateral ligaments.
- (iv) Dissect away the supra-patellar bursa and all diseased synovial membrane.
- (v) Divide the anterior and posterior crucial ligaments, and flex the joint to a right angle.
- (vi) Cut the ligamentum patellæ, and remove the patella.
- (vii) Saw the femur through a plane immediately below the adductor tubercle, holding the saw at right angles to the long axis of the limb, and cutting parallel with the line of the epiphysis.
- (viii) Remove the upper end of the tibia in a similar way, the crucial ligaments and semilunar cartilages (menisci) coming out with the bone. The tibial section varies in thickness from a quarter to half an inch,
- (ix) Dissect away the synovial membrane accompanying the tendon of the popliteus.
- (x) Bring the sawn extremities of the bones into close apposition, stitch up the skin wound, and provide for drainage. Place the limb upon a straight posterior splint.

Describe Kocher's Method.

A J-shaped incision is made. It commences a hand's-breadth above the upper border of the patella, passes down a finger's breadth lateral to it, and curves slightly medially to end just below the tubercle of the tibia,

- STEPS. (i) Cut the skin and fasciæ. In the upper part of the incision divide the vastus lateralis and in the lower part open the capsule.
- (ii) Detach the tubercle of the tibia with its periosteum and the ligamentum patellæ; retract it medially.

- (iii) Divide the capsule over the lateral condyle of the femur.
- (iv) Separate the semilunar cartilages from the top of the tibia. Divide the collateral and crucial ligaments.
- (v) The remaining steps are similar to those detailed in the previous method, except that the patella is not removed, and the ends of the femur and tibia are rounded off. The femur is

Fig. 13.—EXCISION OF KNEE-JOINT BY CURVED ANTERIOR INCISION.



sawn so as to leave a convex surface, and the tibia so as to form a concavity. Fix the tubercle of the tibia back into position.

What is the After-Treatment?

If the sawn surfaces of the bones are accurately apposed, union will result in about six weeks. The knee should then be placed in plaster of Paris for three months, as complete rest is necessary.

Describe the Operation of Meniscotomy.

A displaced or torn medial semilunar cartilage (meniscus) may require partial or total excision; in the majority of cases partial excision suffices.

A three-inch incision is made on the medial side of the knee. It curves downwards and laterally. After dividing the skin and fasciæ, open the capsule by an incision from the ligamentum patellæ to the tibial collateral ligament. Flex and slightly abduct the knee, and inspect the joint.

Most commonly it will be found that a longitudinal tear has occurred through the anterior cornu of the medial cartilage. The cornu is detached with scissors, and the wound closed. If the cartilage is found completely separated, it should be removed. Afterwards the knee has a tendency to a slight degree of genu varum (Kocher).

THE ANKLE.

INDICATIONS (a) EXCISION.—This is usually performed for
FOR tubercular disease.

OPERATION. (b) ARTHRODESIS—Most commonly undertaken for advanced cases of infantile paralysis.

Describe Kocher's Method of Incision.

The incision commences a hand's-breadth above the top of the lateral malleolus, and passes down one finger's-breadth behind the fibula, to terminate on the dorsum of the foot just short of the extensor tendons.

STEPS. (i) Divide the skin and fasciæ. Avoid the short saphenous nerve and vein, and also **the musculo-cutaneous nerve.**

(ii) Divide the lateral annular ligament, and draw backwards the peroneus longus and peroneus brevis. If more room is required the tendons should be divided, and afterwards sutured with fine silk.

(iii) Hook the extensor tendons to the medial side, having previously cut through the anterior annular ligament.

- (iv) Divide the three fasciculi of the lateral ligament.
- (v) Detach the anterior and posterior ligaments of the ankle joint. If possible, **save the deltoid ligament.**
- (vi) Forcibly dislocate the foot medially; the upper articular surface of the astragalus projects from the wound.
- (vii) Remove all diseased synovial membrane.
- (viii) Saw off the upper articular surface of the astragalus, and scrape the articular cartilage from the lower ends of the tibia and fibula.
- (ix) Stitch back the divided ligaments.

What is the After-Treatment?

With a plaster of Paris bandage fix the foot at right angles to the leg; on no account allow any eversion. The bandage should be employed until the wound is completely healed.

THE JAWS.

Describe Excision of the Upper Jaw.

A preliminary laryngotomy should be performed; the upper part of the larynx is packed with gauze to prevent blood or septic discharges from trickling down the trachea, and the anæsthetic is given through the lower part of the opening. In advanced cases, ligature or temporary clamping of the external carotid artery may be advisable.

What is the Incision?

The incision commences half an inch below the medial canthus, passes downwards along the line of junction of the nose and cheek, curves round the ala of the nose, and splits the upper lip in the middle line. Lastly, a transverse incision is carried from the original starting-point to the malar (zygomatic) bone; it runs immediately below the inferior orbital margin, and is slightly convex downwards.

Give the Steps.

- (i) Carry both the transverse and the vertical parts of the incision down to the bone.
- (ii) Dissect off the cheek-flap, and secure the cut arteries; they are the transverse facial from the superficial temporal, infra-orbital from the internal maxillary, superior coronary from

Fig. 14.—EXCISIONS OF THE JAWS.



the facial (external maxillary), and the lateralis nasi from the facial.

- (iii) Separate the nasal cartilage from the nasal bone, and displace the nose inwards.

- (iv) Dissect up the periosteum from the floor of the orbit as far back as the sphenomaxillary (inferior orbital) fissure; protect the eyeball with a spatula.

- (v) With a saw divide the malar process of the superior maxilla, then the nasal process, and, lastly, the palatal process in the middle line. Some surgeons prefer to remove the central incisor tooth and saw through its socket.
- (vi) Divide the soft palate vertically with a knife.
- (vii) Seize the jaw with lion forceps; one blade is applied to the orbit and the other to the palatal surface. Wrench the bone away from the pterygoid plates (laminæ).
- (viii) Check the hæmorrhage with sponge pressure. The descending palatine artery may prove troublesome.
- (ix) Stitch back the cheek-flap, taking care to suture the lip accurately.
- (x) Remove the plug from the laryngotomy opening.

The after-treatment is of the utmost importance or septic broncho-pneumonia may supervene. The patient should be propped up in bed so that he leans forwards. Antiseptic mouth-washes must be frequently used. The patient is fed with a spoon.

Why does the Incision commence below the Inner Canthus?

In order to avoid injury to the—

- (a) Angular artery,
- (b) Ophthalmic emissary vein,
- (c) Lacrimal sac, and
- (d) Suspensory ligament of the eyeball.

Describe Excision of the Lower Jaw.

The central incisor tooth of the affected side should be extracted. By dividing the jaw through its socket instead of in the middle line, the attachment of the genio-hyoglossus is preserved. A preliminary laryngotomy should be performed.

What is the Incision?

Commence the incision just below the red margin of the lip, carry it down to the mental tuberosity, thence along the lower edge of the jaw, round the angle, and upwards as far

as the lobule of the ear. By stopping at this point the facial nerve is avoided. Except in the vicinity of the facial vessels (external maxillary) cut down to the bone.

Give the Steps of the Operation.

- (i) Secure the facial (external maxillary) vessels; the vein lies posterior to the artery.
- (ii) Strip up the flap from the lateral aspect of the mandible; it includes the masseter, buccinator, and infra-labial muscles. Tie the mental vessels.
- (iii) With a Gigli saw divide the bone through the socket of the central incisor tooth.
- (iv) Pass the knife along the lingual surface of the bone, dividing the anterior belly of the digastric and mylo-hyoid muscles.
- (v) Identify the lingula, and feel the internal lateral (spheno-mandibular) ligament attached to it.
- (vi) Divide the inferior dental (alveolar) vessels between two ligatures. They are sheltered by the ligament.
- (vii) Cut the ligament and the inferior dental (alveolar) nerve.
- (viii) Separate the superior constrictor of the pharynx and the internal pterygoid.
- (ix) Depress the bone and detach the temporal muscle from the coronoid process. (An alternative method consists in snipping off the coronoid process with bone forceps.)
- (x) Rotate the bone well outwards, divide the external pterygoid, and open the capsule. **Avoid injury to the internal maxillary artery.** Many surgeons leave the condyle and external pterygoid intact.
- (xi) Divide the stylo-maxillary and pterygo-maxillary ligaments.
- (xii) Close the wound, and treat on similar lines to those carried out in removing the upper jaw.

What are the Indications for Excision of the Jaws ?

- (a) Periosteal sarcoma.
- (b) Secondary carcinoma.
- (c) Necrosis.
- (d) Cystic odontomas.

Describe Excision of the Temporo-Maxillary Joint.

This operation has been performed for ankylosis. A horizontal incision one and a half inches in length is made over the joint, along the lower edge of the zygomatic arch. The superficial temporal vessels and the auriculo-temporal nerve, which lie immediately in front of the ear, are avoided.

Give the Steps.

- (i) Divide the skin and fasciæ; displace the parotid gland downwards.
- (ii) Separate the masseter muscle from the zygomatic arch.
- (iii) Cut the lateral ligament.
- (iv) Saw through the neck of the jaw.
- (v) Seize the condyle with lion forceps, and divide the external pterygoid.
- (vi) If possible leave the interarticular fibro-cartilage; finally, close the wound.

Describe Esmarch's Operation.

This operation is performed for ankylosis of the temporo-maxillary joints. A wedge-shaped area of bone is excised from the body of the lower jaw. Make an incision immediately below and parallel with the lower margin of the bone. Tie or displace the facial vessels and remove a wedge with the base below. (Fig. 15.) Be careful not to splinter the bone. The mental vessels will require ligature.

What is the Operative Treatment for Empyema of the Antrum of Highmore (Maxillary Antrum)?

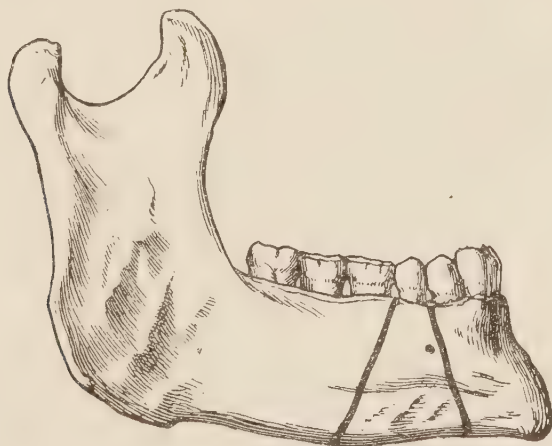
There are three methods of reaching the antrum of Highmore—

- (a) Through the nasal cavity,
- (b) Through the alveolar margin,
- (c) Through the canine fossa.

Describe the Nasal Operation.

Apply cocaine to the inferior meatus. With a fine trocar puncture the lateral wall of the inferior meatus half an inch

Fig. 15.—ESMARCH'S OPERATION.



behind the anterior extremity of the inferior turbinate (concha). Direct the instrument upwards, laterally and slightly backwards.

Describe the Alveolar Operation.

Extract any carious premolar or molar teeth, and perforate through the socket of the first molar or last premolar. In the case of the former tooth, direct the trocar upwards and a little medially: for the latter, upwards and slightly backwards.

Describe the Radical Operation.

The radical operation is carried out through the canine fossa. Evert the upper lip, and divide the reflection of mucous membrane from the lip to the gum. Split the periosteum over the fossa, and break through the bone. Cut away the floor of the canine fossa, scrape out the antrum, and make a counter opening into the inferior meatus. **Avoid injury to the nasal septum.** Dry out the antrum with gauze. Stitch the periosteum over the fossa, and replace the soft parts.

NERVES OF THE EXTREMITIES.

Describe Stretching of the Great Sciatic Nerve.

The incision commences at the glutæal fold, and extends vertically down the back of the thigh for a distance of three or four inches. The line of the nerve is almost midway between the great trochanter and the tuber ischii.

STEPS. (i) Divide the skin and fasciæ. Tie the transverse branch of the lateral circumflex artery.

(ii) Identify the long tendon of the biceps muscle. It crosses the nerve from the medial side.
Displace the muscle medially.

(iii) Stretch the nerve with the finger; afterwards lift the patient's leg from the table by pulling on the nerve.

(iv) Close the wound.

How is the Internal Popliteal (tibial) exposed?

Make a vertical incision three inches long in the middle of the popliteal space. Divide the skin and fasciæ, avoiding the short saphenous vein. On separating the muscles bounding the space, namely the biceps above and laterally: the semimembranosus and semitendinosus above and medially: and the gastrocnemius below. A good view of the nerve is obtained. It lies on a superficial plane to the vessels.

Describe a Method of exposing the External Popliteal (Common Peroneal).

The incision is two to three inches in length, and runs parallel to the medial border of the tendon of the biceps. The nerve will be found between the biceps tendon and the lateral head of the gastrocnemius muscle. A curved incision, two inches long, just below the head of the fibula, will likewise expose the nerve.

Describe Exposure of the Ulnar.

The nerve may be reached either (a) in the upper arm, or (b) at the elbow, or (c) immediately above the wrist. In the first case, the steps are similar to those of ligature of the brachial artery in the middle of its course. To reach the nerve at the elbow, make a small vertical incision over the interval between the olecranon process and the medial humeral epicondyle. At the wrist the steps for exposing the nerve resemble those for ligature of the ulnar artery.

Describe Exposure of the Median.

The site of operation is usually in the lower part of the forearm just above the wrist. Make a vertical incision two inches long midway between the two styloid processes. Dissect in the interval between the tendons of the palmaris longus and flexor carpi radialis; the nerve will be found adhering to the under surface of the flexor sublimis digitorum.

Sometimes it is necessary to expose the median at a higher level in order to anastomose it with the musculo-spiral. For this purpose an incision is made similar to that for ligature of the brachial artery in the antecubital fossa.

Describe Exposure of the Musculo-spiral (Radial).

The nerve may be reached either in the musculo-spiral groove, or in front of the elbow. In the former case, make a three-inch incision vertically down the middle of the posterior surface of the upper arm. Carefully dissect through the triceps muscle, until the groove is recognised; the superior profunda branch of the brachial artery is pulled

to one side, and the nerve dealt with according to the condition found.

To find the nerve in front of the elbow, make an incision two inches long in the lateral bicipital sulcus.

STEPS. (i) Divide skin and fasciæ ; **avoid the median-cephalic vein and the musculo-cutaneous nerve.**

(ii) Identify the lateral edge of the biceps, and displace the muscle medially.

(iii) Dissect in the interval between the supinator longus (brachio-radialis) and brachialis anticus until the nerve is reached.

OPERATIONS ON VEINS.

The intra-venous method of introducing saline fluid into the circulation is undertaken for severe hæmorrhage, or for marked surgical shock. If possible the median-basilic vein is selected.

FLUID USED Physiological salt solution (a drachm of NaCl to a pint of H_2O), which has been sterilised by boiling, and to which has been added a few minims of adrenalin chloride.

TEMPERATURE 100-104° F.

QUANTITY USED 1-3 pints.

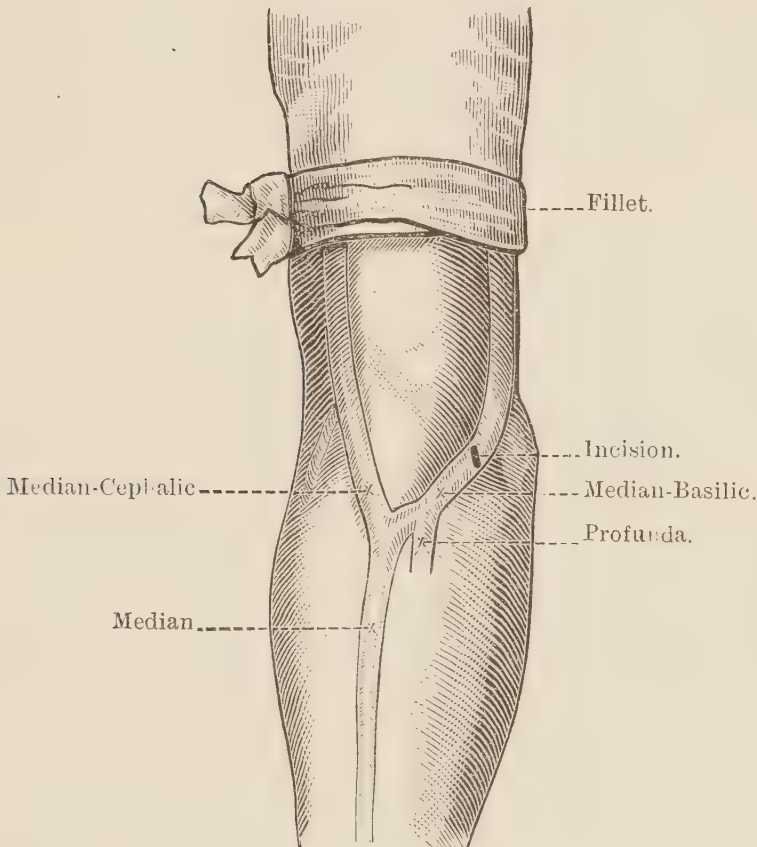
RATE OF INTRODUCTION . 15 minutes for each pint of fluid.

Describe the Method of Transfusion.

The veins are made prominent by means of a bandage fixed round the upper arm. Make an incision in the medial bicipital sulcus over the vein. Introduce two catgut ligatures round the vein an inch apart ; tie the lower one so as to empty the segment above. Open the vein by an oblique or a V-shaped incision, and place a cannula within its lumen ; tie the upper ligature so as to keep the cannula

in position. Fix the rubber delivery-tube to the cannula, and allow the fluid to enter the vein. **Be careful that no air enters.** When all the fluid has been introduced, withdraw the cannula and secure the upper ligature. Divide the vein between the two ligatures, and stitch up the skin.

Fig. 16.—TRANSFUSION.



Describe Intravenous General Anæsthesia.

Expose the median-basilic vein as before. Introduce 8 $\bar{3}$ of a 5% solution of ether in normal saline, through a tube and cannula. The temperature of the fluid is about 100°F. Anæsthesia ensues in four to five minutes. In order to maintain the anæsthesia an additional quantity of the fluid is allowed to run in at intervals.

Mention the Common Operations for Varix of the Long Saphena.

1. Trendelenburg's.
2. Mitchell's.
3. Mayo's.
4. Babcock's.

Describe Trendelenburg's Operation.

Carry an oblique incision, three inches long, downwards and inwards over the saphenous opening. Isolate the upper part of the vein, clearing a segment about two inches in length. Tie any communicating tributaries, and resect the exposed portion between two ligatures. Stitch up the skin incision.

Describe Mitchell's Operation.

Make a small transverse incision, half an inch broad, immediately below the saphenous opening, and dissect out the vein. Ligate the proximal end of the exposed section, clamp the distal end, and divide the vein. Gentle traction on the clamp will render the rest of the vein visible through the skin. Repeat the steps some distance below the seat of the first operation, and tear out the intervening segment. By similar means it is possible to resect the whole vein. Suture the various skin incisions.

After the operation, bandage the limb from below upwards, and elevate the leg for a few days.

Describe Mayo's Method.

Neither the operation of Mayo nor that of Babcock can be employed when the vein wall is calcareous, or where there is great tortuosity.

Expose the vein just below the saphenous opening; divide the vein and ligate the upper end. Take the "stripping" forceps and pass them along the lower part of the vein as far as possible, then thread the vein through the "ring-enucleator." This instrument separates the vessel from its surroundings, and also severs all collateral tributaries. When the "enucleator" has been pushed down as far as it will go, make a small incision over the ring, and drag out

the segment. Repeat the steps until the desired length of the vein has been taken away.

Describe Babcock's Operation.

The upper part of the long saphena is exposed, as in previous methods; the vein divided, and the proximal end ligated. Babcock's "stylet" is introduced into the distal end of the vessel, and gently pushed down the interior. A small incision is made through the skin and fasciæ over the lower acorn-bulb of the instrument, and the vein tied on each side of the bulb. Now divide the vessel between the ligatures, and avulse it by pulling on the upper end of the "stylet."

OPERATIONS ON BONES.

Describe Sub-periosteal Resection.

Sub-periosteal resection of the shaft of a long bone is performed for diffuse tuberculous osteomyelitis in children (Stiles). By means of X-rays the area of bone to be removed is determined, and an incision planned which will avoid the main blood vessels and nerves of the part. Detach the periosteum a little below the disease, and divide the bone with a Gigli saw. Pull the proximal segment forwards, loosen the periosteum as far as a point a little beyond the seat of disease, and again divide the bone. Check hæmorrhage, and stitch up the periosteum with interrupted catgut sutures. Replace the soft parts, and close the skin incision. New bone is formed, complete union occurring in about four months.

How is a Patella "Wired"?

Outline the patella by means of an inverted U-shaped incision. Dissect the flap off the bone, thus exposing the seat of fracture. Remove all blood from the joint by washing it out with saline solution. Wipe the broken ends of the fragments with gauze. Cut away any torn fringes of periosteum, and wire the fragments transversely, taking great care that the wire does not encroach upon the

articular cartilage. After tightening and twisting the wire, cut off the excess, and with a mallet hammer the ends into the upper fragment.

Describe Osteotomy.

A bone may be divided straight across, **linear osteotomy**, or a wedge-shaped portion may be cut out, **cuneiform osteotomy**. The operation is usually performed by means of an osteotome or an Adam's saw. An excellent example of a linear osteotomy is Macewan's operation for genu valgum.

Describe Macewan's Operation for Genu Valgum.

Flex the knee of the deformed limb, and rest its outer side upon a sandbag. By flexing the knee the joint cavity is not opened into. The operation is performed through the genu valgum triangle, whose boundaries are: *in front*, the vastus medialis; *behind*, the tendon of the adductor magnus, with the deep branch of the anastomotica magna artery; *below*, the superior medial articular artery.

Take a point half an inch in front of the adductor tubercle, and draw a vertical line; then draw a horizontal line through a point half an inch above the lateral tuberosity of the femur. At the intersection of the two lines introduce an osteotome down to the bone. Turn the instrument round so that it lies at right angles to the long axis of the thigh. Divide two-thirds of the diameter of the bone, working from behind forwards and from the medial to the lateral side. Fracture the remaining third of the bone by bending the limb over the sandbag. Dress the wound and fix the limb to a posterior splint.

Describe Cuneiform Osteotomy for Genu Valgum.

The knee-joint must be flexed, and its lateral side rest upon a sandbag. Make a small incision in the long axis of the femur, one inch in front of the tendon of the adductor magnus.

STEPS. (i) Cut through the skin and fasciæ; identify the vastus medialis.

- (ii) Divide the muscle in the line of the original incision. Tie any branches of the anastomotica magna artery met with.
- (iii) Divide the superior medial articular vessels between two ligatures.
- (iv) With the osteotome cut out a wedge of bone, the base of the wedge being on the medial side.

Describe Adam's Osteotomy.

The object of this operation is to divide the neck of the femur; it is performed when the limb is fixed in a position of adduction and flexion.

Make a small incision down to the bone at a point half an inch above the summit of the great trochanter. The knife passes between the sartorius and the tensor fasciæ femoris, then between the rectus femoris and the glutæus medius and minimus. Introduce an Adam's saw along the knife, then withdraw the latter. Divide the neck of the femur, dress the wound, and put the limb up in abduction. In severe cases the adductor muscles may require division.

Describe Gant's Osteotomy.

This operation is a sub-trochanteric osteotomy. The bone may be divided in a straight line, or a wedge may be excised. The indication is similar to that for Adam's procedure.

Take a point half an inch below, and half an inch in front of the top of the great trochanter. Divide the soft parts down to the bone; then, with an osteotome or an Adam's saw, cut the bone downwards and medially. In cuneiform operations the base of the wedge is taken from the lateral side. As before, put up the leg in abduction.

Describe Trans-trochanteric Osteotomy.

This operation is also undertaken to remedy permanent adduction of the hip, and may be either linear or cuneiform. The incision is made obliquely on the lateral side of the great trochanter, and goes to the bone. The femur is divided downwards, forwards, and medially towards the lesser trochanter. Put up the limb in the abducted position.

VERTEBRAL COLUMN.

What are the indications for Laminectomy?

- (a) Removal of extra-dural or meningeal tumours.
- (b) Extra-medullary hæmorrhage causing severe pressure symptoms.
- (c) Chronic spinal meningitis, in order to irrigate the theca.
- (d) Fracture-dislocation of the spine (rarely).
- (e) Section of the posterior nerve-roots in inoperable tumours, or to relieve the girdle pains or gastric crises of locomotor ataxia.
- (f) Removal of pus, granulation tissue, or a sequestrum in Potts' disease.

Describe the Operation of Laminectomy.

Place the patient in the prone position, and make a vertical incision over the spinous processes of the vertebræ whose laminæ are to be removed. If more room is required, this incision may be supplemented by two transverse cuts at the upper and lower ends.

STEPS. (i) Divide the skin and fasciæ.

- (ii) Separate the muscles from the laminæ with a knife and periosteal elevator. Check the hæmorrhage, which may be formidable, by sponge pressure.
- (iii) With strong bone-forceps snip off the spinous processes; cut the supra-spinous and inter-spinous ligaments above and below the divided processes.
- (iv) On each side saw through the laminæ at their junction with the pedicles.
- (v) Divide the ligamenta subflava above and below, and remove the area of bone.
- (vi) If it is necessary to open the dural sheath, first displace the venous plexus which lies between that membrane and the bone. Pick up the dura mater, and divide it cautiously in the middle line.

When the operation is undertaken for chronic spinal meningitis, the dural sheath is irrigated with 1-1000 corrosive sublimate.

What is the After-Treatment of Laminectomy?

Close the wound, leaving a space for drainage. The bone flap should not be replaced. The dressings must be frequently changed, owing to the abundant discharge following the operation. Maintain the strictest asepsis, or infection of the meninges, with disastrous consequences, will result. When healing has occurred, a poroplastic jacket can be provided to support the spine.

Give the Indications for Lumbar Puncture.

- | | | |
|--|---|---|
| <p>A.—FOR DIAGNOSTIC PURPOSES . . .</p> | { | <p>(i) Cerebro-spinal meningitis. (ii) Wassermann's reaction in syphilitic nerve dis- orders. (iii) Diffuse cerebral lepto- meningitis. (iv) Tubercular meningitis. (v) Cerebral hæmorrhage.</p> |
| <p>B.—FOR THERAPEUTICAL PURPOSES . . .</p> | { | <p>(i) Injection of magnesium sulphate in acute tetanus ($\frac{1}{2}$-1 3 of a 25% sterilised aque- ous solution). (ii) Repeated tapplings are performed for diffuse cerebral lepto - men- ingitis. (iii) To relieve the pressure symptoms in inoper- able cerebral tumours. "Decompression" operations on the brain have almost entirely superseded tapping [of the cere- bro-spinal fluid.</p> |
| <p>C.—FOR SPINAL ANALGESIA.</p> | | |

Describe Bier's Method of obtaining Spinal Analgesia.

A small quantity (.05 gramme) of tropococaine is dissolved in 1 c.c. of sterilised water to which 1 minim of adrenalin chloride (1 in 1000) has been added. By lumbar puncture 10 c.cs. of cerebro-spinal fluid are obtained. They are added to the tropococaine and adrenalin, and the mixture is slowly injected into the arachno-pial space.

How is Lumbar Puncture Performed?

The patient should be seated upon a low stool, with his body bent forwards. Draw a line joining the highest parts of the iliac crests; the line will pass through the fourth lumbar spine. Half an inch above the line will indicate the interval between the third and fourth lumbars; half an inch below, that between the fourth and fifth lumbars. The needle can be introduced through either interspace; if it pass in the middle line the supra-spinous and inter-spinous ligaments must be traversed, if a little to one side, the ligamentum subflavum is encountered.

Direct the needle forwards, slightly upwards and medially. The arachno-pial space, in the meshes of which the cerebro-spinal fluid will be reached, lies at a distance of two inches from the surface. Note the feeling of resistance when the needle penetrates the ligamentum subflavum.

The early drops of fluid may be slightly blood-stained, due to the puncture of a small extra-dural vein.

What Quantity of Fluid should be drawn off?

| | | | |
|-------------------------------|---|---|-------------|
| A.—FOR DIAGNOSTIC PURPOSES | . | . | 5 c.cs. |
| B.—FOR THERAPEUTICAL PURPOSES | . | . | 30-40 c.cs. |
| C.—FOR SPINAL ANALGESIA | . | . | 10 c.cs. |

Describe Albee's Operation for Potts' Disease.

This is a bone-graft operation undertaken to ankylose the affected portions of the spine. The two main contra-indications are—(i) marked sepsis; and (ii) excessive scar-tissue in the area. The bone-graft is taken from the medial surface of the patient's tibia.

The incision extends from the healthy vertebræ above to the healthy vertebræ below. The supra-spinous and inter-spinous ligaments are split vertically. Saw through the spinous processes for $\frac{1}{3}$ to $\frac{2}{3}$ inch deep, and snap off one-half at the base, in order to make a bed for the graft. Bend a flexible probe over the bed; this serves as a model. Cut out a piece of bone from the tibia similar to the model. When the graft has been removed, it is rendered flexible by sawing transverse grooves in it; these grooves are $\frac{1}{3}$ inch deep. Place the graft in its bed, and secure it there by suturing the cut ligaments over it. Close the wound.

The after-treatment consists in keeping the patient recumbent on his back on a fracture-bed for five to six weeks.

THORAX.

Describe Paracentesis of the Pericardium.

This operation may be necessary for serous pericarditis. Introduce the needle through the fifth intercostal space, about one inch from the lateral sternal margin. In this way the internal mammary vessels are avoided.

Describe Drainage of the Pericardium.

Make a transverse incision one and a half inches long in the fourth intercostal space, commencing at the edge of the sternum. Divide the superficial structures, pectoralis major, intercostal muscles and fasciæ, and resect a portion of the fifth costal cartilage. Avoid the internal mammary vessels and their intercostal branches. The operation is undertaken for purulent pericarditis.

Describe the Operative Treatment for a Wound of the Heart.

To thoroughly expose the anterior surface of the heart and pericardium the external hinge-flap devised by Peck will prove the most satisfactory. The vertical part of the incision extends down the middle of the sternum from the

third to the sixth costal cartilages; the transverse incisions are carried along the third and sixth ribs as far as the mid-clavicular line.

STEPS. (i) Dissect up the skin, fasciæ, and mammary gland.

(ii) Detach the pectoralis major and rectus abdominis from their sternal and costal origins.

(iii) Separate the anterior intercostal membrane and internal intercostal muscle from the third, fourth, fifth, and sixth costal cartilages.

(iv) With bone-forceps divide each of the exposed cartilages from its sternal attachment.

Work from below upwards.

(v) Bend the cartilages laterally until they break at their junction with the ribs.

(vi) Secure the internal mammary vessels between ligatures, and carefully displace the left lung and pleura.

(vii) Incise the pericardium, or enlarge any pre-existing wound.

(viii) Digital compression of the superior vena cava near its entrance into the right auricle will materially check any hæmorrhage.

(ix) Remove all blood-clot, and close the cardiac wound with fine catgut. **The stitches must not enter the cavity of the heart.**

(x) Suture the pericardium with fine silk, and replace the flap.

Describe Transpleural Laparotomy.

This operation may be undertaken for subphrenic abscess, tropical abscess, or suppurating hydatid cysts. A three-inch incision is made along the eighth intercostal space, the centre of the incision being in the mid-axillary line.

STEPS. (i) Dissect down to the intercostal muscles, dividing portions of the latissimus dorsi and external oblique on the way.

(ii) Resect subperiosteally about three inches of the 8th and 9th ribs; remove the intercostal

- muscles. The costal portion of the parietal pleura is exposed.
- (iii) Shut off the area of the pleural cavity by uniting the costal and diaphragmatic layers with a continuous circular stitch.
 - (iv) Make an incision through the two layers, and then through the diaphragm. The peritoneum is usually adherent to the liver, so does not require shutting off.
 - (v) Incise and empty the abscess cavity. Drainage will be subsequently required. The diaphragm is fixed to the wound with a few catgut stitches.

How is Acute Empyema treated Surgically?

By resecting a portion of a rib in the mid- or posterior axillary line. The patient should rest upon his back, and the side to be operated upon should project beyond the edge of the table. Select the rib to be dealt with (usually the 7th or 8th), pull up the skin over it, and make a three-inch incision, the centre of the incision being in the mid-axillary line.

Sometimes the 9th rib is chosen, and the centre of the incision made in the posterior axillary line. In every case take care that the direction of the incision coincides with the long axis of the rib.

What are the further Steps?

Divide the superficial structures, muscles, and periosteum. With a curved periosteal elevator freely detach the periosteum from the exposed portion of rib; by this procedure the intercostal vessels are not endangered. Remove one and a half inches of the rib with bone forceps, and thrust a director through the parietal pleura. Partially plug the opening with the finger, and allow the pus to escape very slowly, or acute dilatation of the heart may result. When the contents of the empyema have ceased to flow, introduce two large rubber drainage tubes into the cavity. The tubes should be specially prepared, so that only the portion projecting into the cavity is per-

forated. Suitable precautions must be taken to prevent aspiration of the tubes into the thorax during inspiration, the simplest plan being to fix the outer end of each tube with a strong safety-pin.

Describe the Operative Treatment of Chronic Empyema.

Either Estlander's or Schede's operation can be performed ; the former is used for small cavities, the latter when the disease is more extensive. In Estlander's operation a vertical incision is made over the cavity, the soft parts separated, and portions of ribs excised subperiosteally. In Schede's operation a large horse-shoe shaped musculo-cutaneous flap is formed. It usually extends from the 3rd to the 9th ribs. Dissect the flap of the costal wall, resect part of each of the ribs subperiosteally, secure the intercostal vessels, and cut away the intercostal muscles and periosteum. The parietal pleura is then removed, and the visceral pleura scraped with a sharp spoon. Lastly, replace the flap of soft tissues. After the patient has recovered from the operation, suitable breathing exercises should be prescribed.

What are the Indications for Pneumotomy?

Incision of the pulmonary substance may be necessary for—

- (a) The evacuation of an abscess.
- (b) The opening of a hydatid cyst.
- (c) Drainage of a bronchiectatic cavity.
- (d) Drainage of a phthisical cavity.
- (e) The removal of a foreign body.

Describe Pneumotomy.

The operation can be undertaken in two stages. In the first place, make an incision along the rib bounding the lowest level of the abscess cavity ; excise two inches of the rib, thus exposing the parietal pleura. Stitch the lung to the parietal pleura by means of a continuous circular suture. Plug the wound with iodoform gauze, and wait a few days. Introduce a trocar and cannula into the cavity, and connect the instrument to an aspirator. Empty the abscess, and introduce a drainage tube or pack with gauze.

Describe an Operation for Emphysema.

Make a curved incision, with the convexity towards the sternum, from the second to the sixth interspaces. Divide the superficial structures, pectoralis major, and intercostal muscles. In the second interspace tie the internal mammary artery and its venæ comites. Remove the costal cartilage, and an inch of each rib, from the second to the sixth inclusive. The periosteum must also be taken away.

MAMMARY GLAND.*How would you open a Mammary Abscess?*

If the abscess is in the substance of the gland, make an incision over the swelling in a direction radiating from the nipple: by this means injury to the lactiferous ducts is avoided. Explore the abscess cavity digitally, and break down any loculi. Pack with gauze, and subsequently support the breast with a bandage.

Give the Treatment for a Retro-Mammary Abscess.

A retro-mammary abscess is best approached through Gaillard Thomas's incision, *i.e.* in the thoraco-mammary fold, slightly convex downwards. Divide the skin and superficial fascia, dissect up the gland slightly from the pectoral fascia, and introduce a director until pus is reached. Pass a pair of dressing forceps along the director, and open the blades (Hilton's method). When the contents of the abscess cavity have been evacuated, a drainage tube is introduced, and the breast replaced in position.

How is a Benign Tumour Removed from the Breast?

When the tumour is placed superficially in the gland it can be removed through an incision similar to that employed for a mammary abscess. On the other hand, if the tumour implicates the deep part of the breast, Gaillard Thomas's incision is used. The inferior border of the pectoralis major is recognised, the gland stripped off the pectoral fascia, and

the tumour excised along with a wedge-shaped area of breast tissue. Narrow the gap with a few buried sutures, and replace the mamma. Drain the wound for thirty-six to forty-eight hours.

Classify the Lymphatics of the Breast.

1. Cutaneous.
2. Sub-areolar plexus.
3. Circummammary.
4. Retromammary.
5. Intramammary.

Give the Lymphatic Drainage of the Breast.

- (a) *Upper part*.—Into the infraclavicular and supra-clavicular glands.
- (b) *Medial part*.—Into the sternal glands (accompanying the internal mammary vessels) and partly to the lymphatics of the opposite breast.
- (c) *Lower part*.—Into the fascial plexus of the anterior abdominal wall.
- (d) *Lateral part*.—Into the pectoral, axillary, central, and subscapular glands.
- (e) *Deep part*.—Into the posterior mediastinal glands along the vertebral column.

What Structures must be removed in a Radical Operation?

1. The breast, with the overlying skin and the surrounding fat.
2. The pectoralis major, whole or in part.
3. The pectoralis minor, whole or in part.
4. The costo-coracoid membrane and the infra-clavicular glands.
5. All the lymphatic glands, fat, and loose areolar tissue of the axilla, especially the fascia over the subscapularis and serratus magnus (anterior). Remember the gland associated with the superior thoracic vessels on the first interspace.
6. The fascia covering the upper portions of the external oblique and rectus abdominis muscles.
7. The supra-clavicular glands, if necessary.

What Structures should the Surgeon try to avoid when clearing out the Axilla?

1. The **cephalic vein**, in the skin incision, and when separating the costo-coracoid membrane.

2. The **axillary vein**, when dissecting away the axillary and subclavicular glands.

3. The **nerve of Bell** (lateral thoracic), when removing the pectoral glands.

4. The **long subscapular nerve**, when removing the subscapular glands.

Describe the first part of the Radical Operation.

A great many methods have been practised ; we shall here describe Kocher's operation.

With the arm fully abducted from the side, commence the incision at the middle of the clavicle, carry it down immediately medial to the delto-pectoral furrow, over the great pectoral muscle, as far as the posterior axillary fold.

STEPS. (i) Divide skin and fascia, draw aside the cephalic vein, and tie the humeral branch of the thoracic axis artery.

(ii) Divide the axillary fascia, and cut the tendon of the pectoralis major about one inch from its insertion into the lateral lip of the bicipital groove.

(iii) Cut the pectoralis minor at its attachment to the coracoid process.

(iv) Remove the costo-coracoid membrane and the infraclavicular nodes.

(v) Clear the glands, fat, and areolar tissue from the axilla, working from the apex downwards. The superior thoracic, thoracic axis, long thoracic, and subscapular vessels may require ligature. If the axillary glands are adherent to the vein, it may be necessary to excise this portion of the vein between two ligatures. Remember that air embolism is likely to follow accidental puncture of the vein.

- (vi) Lastly, complete the clearance of the axilla by dissecting the axillary fascia off the posterior fold of the cavity.

How is the Breast removed ?

From the lower end of the first incision an ellipse is carried round the breast, keeping wide of the tumour, as far as the sternum. The ellipse divides skin only.

- STEPS. (i) The upper segment of the ellipse can be first dealt with. The skin is dissected upwards to the lower border of the clavicle, and medially as far as the middle of the sternum.
- (ii) At the lower segment, the skin is reflected downwards until the fascia clothing the upper portion of the external oblique and rectus abdominis muscles is exposed.
- (iii) Working from above downwards, dissect the pectoralis major, pectoralis minor, the fascia and fat covering them, and the breast with its adherent skin, off the costal wall, tying the perforating branches of the internal mammary artery.
- (iv) Introduce a large drainage tube in the posterior part of the wound, and suture the flaps together. If complete apposition cannot be obtained, Thiersch grafting may be necessary.
- (v) Dress the wound, and pad the axilla with plenty of wool. The arm is well abducted, flexed at the elbow, and supported upon a pillow. The tube should be removed on the second or third day.

How may Inoperable Mammary Cancers be dealt with ?

Sir George Beatson removes the ovaries and Fallopian tubes, then puts the patient upon a course of thyroid gland tablets. The operation must be performed before the menopause is reached. Locally, X-rays or radium may be employed in addition.

OPERATIVE SURGERY.

PART II.

AMPUTATIONS.

What are the Cardinal Rules to remember when performing an Amputation ?

1. Plan the incision so that the flaps consist of tissue having an abundant vascular supply.

2. If possible, choose flaps from parts already accustomed to bear pressure.

3. Take care that the flaps are of sufficient length not only to cover the ends of the bones but also to allow of subsequent retraction of the soft parts. The total length of the flaps should be one-and-a-half times the diameter of the limb at the point of section of bone. There is only one exception to this rule, and that is the middle of the thigh ; here the total length of the flaps should be twice the diameter of the limb at the point of section of bone.

4. All nerves should be cut short.

5. In the *lower* extremity, a *broad* stump is required ; in the *upper* extremity, a *long* stump.

6. The cicatrix should not be terminal.

7. Do not pull the tendons out of their sheaths before division.

8. Sever the chief blood vessels at right angles, not obliquely.

What Points have to be attended to in Sawing the bone ?

The periosteum having been divided by the knife, the *heel* of the saw is placed on the bone, the blade being steadied by resting against the second joint of the left thumb ; the saw is now drawn towards the surgeon, with firm pressure through its full length. The object of doing this is to make a groove in which the saw shall run smoothly without danger of slipping out and lacerating adjacent parts. Next, use long, *light*, sweeping movements from point to heel, the assistant in the meantime holding the bone in such a way that he does not “ lock ”

the saw by raising it, nor snap it through, before completing division, by depressing it.

In the forearm the two bones are practically of equal size and so they should be sawn through together. In the leg where the bones are unequal in size, the saw is first made to "bite" the tibia, but the fibula should be divided first. In the case of the femur consider the *linea aspera*, a small bone, and divide it before the rest of the femur is completely sawn through. Gentle traction on the assistant's part will often avoid splintering.

Mention the Chief Methods of Amputation.

- (a) The circular (the "triple incision").
- (b) The modified circular (Syme).
- (c) The elliptical.
- (d) The oval or racket.
- (e) The flap (Liston).

Describe the Circular Method.

(1) The SKIN is drawn upwards and then the *skin and fat* are divided by a circular sweep of the knife, and retracted or dissected back for a distance equal to half the diameter of the limb.

(2) The MUSCLES are next divided at the level of the retracted skin by another circular sweep of the knife, and also retracted as far as possible.

(3) Lastly, the BONE is cleaned and sawn as high up as possible. The object of this *triple incision* is to prevent the "sugar-loaf stump." Its disadvantage is that the cicatrix is opposite the end of the bone and often adherent to it: this is specially objectionable in the lower limb. As the tissues are divided, layer after layer, the assistant must continue to retract.

The circular method is particularly suitable when amputating through a cylindrical portion of a limb, *e.g.* the upper arm.

Describe the Modified Circular Method.

Two short semilunar flaps are made, merely including the skin and fat; the flaps are then retracted or dissected up, the muscles divided circularly at the bases of

the flaps, and the operation completed as before. This plan is of great value when amputating through *cone-shaped* parts, as in this method the skin can be retracted more easily. It also affords the longest possible stump and gives the smallest possible wound.

Describe the Elliptical Method.

The upper end of the ellipse should commence about half an inch distal to the level of the section of the bone ; the lower end is carried round the limb at a distance from the upper end equal to the diameter of the limb. The skin and fat are retracted, the muscles divided, and the bone cleared as before. The advantages of the elliptical method are—(a) an abundant covering is formed for the stump ; (b) there is not much destruction of the soft parts ; and (c) the cicatrix is lateral.

How is the Oval or Racket Method performed ?

This is specially used in disarticulation of the fingers and toes, and at the shoulder and hip. It is a circular amputation reinforced by a straight incision. At the junction of the straight and the circular parts the angles are rounded off. When the handle of the racket is short the term *oval* method is generally used.

What are the Features of an Ideal Stump ?

- (i) It should be of a suitable length for an artificial limb.
- (ii) The end is covered only by skin and superficial fascia.
- (iii) The covering at the end should be slack and freely movable.
- (iv) There is no redundant skin or pointed corners.
- (v) The scar is linear and not adherent to the bone.
- (vi) The scar should be free from sinuses, and the edges should not be turned in.
- (vii) Absence of pain and tenderness.
- (viii) Freedom from oedema.
- (ix) There should be no necrosis of bone in the stump.

- (x) The joint immediately above the site of amputation should possess a full range of voluntary movement (Huggins).

Before an artificial limb can be fitted the stump must be thoroughly shrunk, *i.e.* free from œdema.

How would you hasten the Shrinking of a Stump?

(a) The stump and limb are massaged daily.

(b) A firm bandage is applied over the stump before rising from bed in the morning, and the bandage only removed when the patient is reclining in bed at night.

(c) The scar is rubbed gently with spirit nightly. After the wound has closed, shrinking generally occupies a period of three months.

AMPUTATIONS OF THE SUPERIOR EXTREMITY.

To produce regional anæsthesia of the upper extremity the brachial plexus can be injected with a solution of novocain and adrenalin. This solution may be injected directly into the main nerve trunks—intraneural, or round about these trunks—paraneural.

Describe Intraneural Injection of the Brachial Plexus.

After infiltrating the skin and superficial fascia of the lower part of the posterior triangle of the neck, an incision is made to expose the brachial plexus. This extends from the junction of the middle and lower thirds of the posterior border of the sterno-mastoid, to the upper surface of the clavicle, at the anterior margin of the trapezius. The fifth, sixth, seventh, and eighth cervicals, and the first thoracic nerve trunks are exposed, and a few drops of a five per cent. solution injected into each.

Give the Steps of Paraneural Injection.

Infiltrate the skin and fascia as before. Place the thumb just above the centre of the clavicle, and press backwards so as to cover the subclavian artery. Intro-

duce a long needle immediately to the outer side of the thumb, and push it in the direction of the third dorsal spinous process. The plexus is usually encountered at a depth of about $1\frac{1}{2}$ inches. Attach the syringe, and inject 10 c.c.'s of a two per cent. solution. Withdraw the needle slightly and inject a similar quantity. Anæsthesia is usually complete in from ten minutes to a quarter of an hour.

What are the indications for the Inter-scapulo-thoracic Amputation?

1. Sarcomata involving the region of the shoulder or scapula.
2. Gunshot injuries.
3. Malignant œdema.
4. Extensive recurrent mammary cancer.

Mention the Instruments required.

1. A large, strong amputation knife.
2. A strong scalpel.
3. A Gigli's saw.
4. Retractors and hooks.
5. Bone, lion, dissecting, and artery forceps.
6. Periosteal elevator.
7. Usual instruments for ligature of vessels and for suturing of wound.

Describe the First Stage of the Operation.

Place the patient upon the back and elevate the shoulders. Draw the patient as far as possible to the edge of the table.

Make a horizontal incision along the outer two-thirds of the clavicle cutting directly down to the bone. Separate the periosteum from the middle third of the bone and remove this area with the Gigli saw, meanwhile steadying the clavicle with lion forceps. Having lost the support of the clavicle the limb falls backwards and outwards. The subclavius can now be divided, thus exposing the deep cervical fascia covering the subclavian vessels. Incise this fascia carefully, and identify the

structures on the upper aspect of the first rib. The order from before backwards, and from within outwards is: subclavian vein, scalenus anticus attached to the scalene tubercle, subclavian artery, brachial plexus, and the scalenus medius. Two additional arteries are in close relationship, namely, the suprascapular crossing the subclavian superficially, and the transversalis colli lying about a finger's breadth above it. After ligaturing the transversalis colli and the suprascapular vessels, inject a mixture of novocain and adrenalin into the nerve trunks of the brachial plexus. This is known as "blocking" the nerves, and tends to prevent surgical shock (Crile). This procedure is only necessary when the operation is being performed under general anæsthesia. The nerves should be subsequently divided separately. Cut them with a knife, not with scissors. Now tie the subclavian vessels, the artery before the vein.

Describe the Second Stage of the Operation.

Abduct the arm to a right angle with the trunk, and make an incision from the centre of the clavicle down the front of the shoulder to the anterior axillary fold, then across the base of the axilla, over the posterior axillary fold, and along the side of the thorax as far as the inferior angle of the scapula.

Divide the pectoral muscles, costo-coracoid membrane, axillary vessels and nerves, and the latissimus dorsi. Now forcibly pull the arm over towards the opposite side and turn the patient until he is lying upon his *sound* side. Make an incision from the outer end of the clavicle, over the back of the scapula to its inferior angle. Separate the trapezius from the upper border of the spine of the scapula, cut the posterior belly of the omohyoid, and divide the muscles attached to the vertebral border, namely, the levator scapulæ, rhomboideus major, rhomboideus minor, and the serratus magnus.

Make a small opening in the posterior flap and introduce a drainage tube.

Describe Disarticulation at the Shoulder.

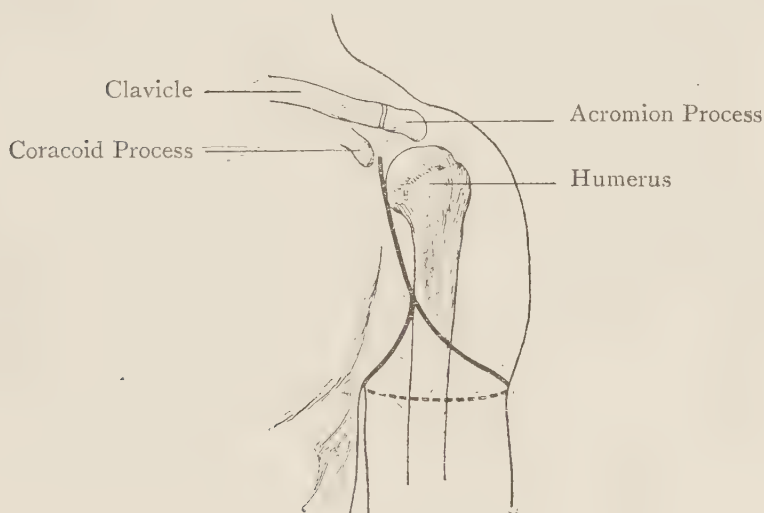
Two chief methods are employed according to the con-

dition of the humerus ; when this is broken, Furneaux-Jordan's operation should be performed, otherwise Spence's method is chosen.

Give the Steps of Spence's Operation.

(1) Abduct the arm and rotate it well outwards. Make an incision commencing immediately external to the coracoid process, carry it down through the clavicular fibres of the deltoid as far as the lower border of the pectoralis major tendon. This incision goes down to the bone. The following are the chief structures

Fig. 17.—SPENCE'S AMPUTATION.



divided :—VEIN, the cephalic ; ARTERIES, branches of the acromio-thoracic, and the anterior circumflex ; MUSCLES, anterior fibres of deltoid, pectoralis major, and long head of biceps.

(2) Carry the lower end of the incision round the outer aspect of the arm, through the lower fibres of the deltoid towards the posterior axillary fold. This portion of the incision goes down to the bone.

(3) Start at the lower end of the original vertical incision and sweep round the inner side of the arm to meet the outer incision. *Divide skin and fat only.*

(4) Deepen the inner incision and secure the main vessels.

(5) Dissect up the deltoid muscle, keeping the knife close to the bone so as to avoid the posterior circumflex artery.

(6) Rotate the arm outwards and divide the capsule and the subscapularis ; then rotate inwards and divide the muscles attached to the great tuberosity, namely, the supraspinatus, infraspinatus, and teres minor.

(7) Pass the knife behind the bone to separate the long head of the triceps, then down the inner side to divide the biceps, coraco-brachialis, latissimus dorsi, and teres major.

Give the Steps of Furneaux-Jordan's Operation.

Furneaux-Jordan's method is indicated where (a) the humerus is broken ; (b) the surgeon is short-handed, and (c) where it is desired to preserve the periosteum of the bone.

(1) Empty the limb of blood, apply an elastic tourniquet to the junction of the arm with the trunk, and secure it by means of an elastic band underneath the shoulder of the opposite side.

(2) At the level of the lower fibres of the deltoid make a circular incision round the arm ; dissect up the flaps and saw off the humerus.

(3) Secure the vessels and remove the tourniquet.

(4) A vertical incision is now made from a point just external to the coracoid process. The soft parts are divided down to the bicipital groove, and the muscles and capsule are dissected off the bone subperiosteally.

What Methods may be adopted in Amputation through the Upper Arm ?

(a) The elliptical—the upper end of the ellipse should lie over the internal bicipital sulcus.

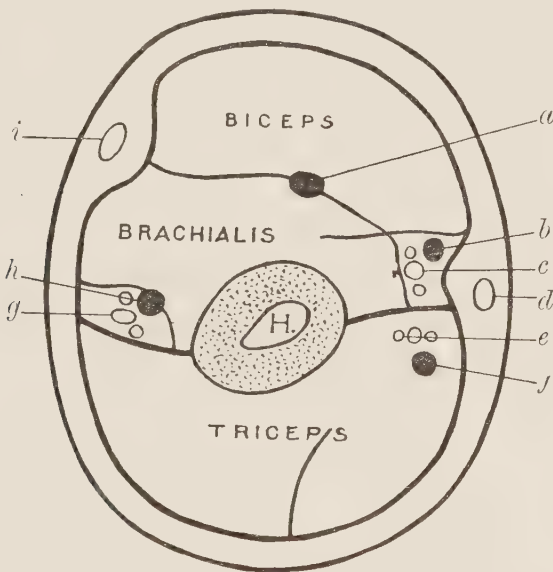
(b) By flaps—these should be *lateral*, not anterior and posterior, as when the latter flaps are made the deltoid is apt to project the bone at the external angle of the incision.

(c) The circular method—the incision is carried round the limb at a point below the level of bone section, a little less than the diameter of the limb.

What are the Structures Divided ?

- I. MUSCLES —Biceps, brachialis anticus, triceps, and (above the middle of the humerus), the deltoid and the coraco-brachialis.
- II. VEINS —Cephalic, basilic, venæ comites of brachial.
- III. ARTERIES—Brachial, superior profunda, and inferior profunda.

Fig. 18.—TRANSVERSE SECTION, MIDDLE OF RIGHT UPPER ARM.
(From Whittaker).



a, Musculo-cutaneous nerve.
b, Median nerve.
c, Brachial artery.
d, Basilic vein.
e, Inferior profunda artery.

f, Ulnar nerve.
g, Superior profunda vessels.
h, Musculo-spiral nerve.
i, Cephalic vein.

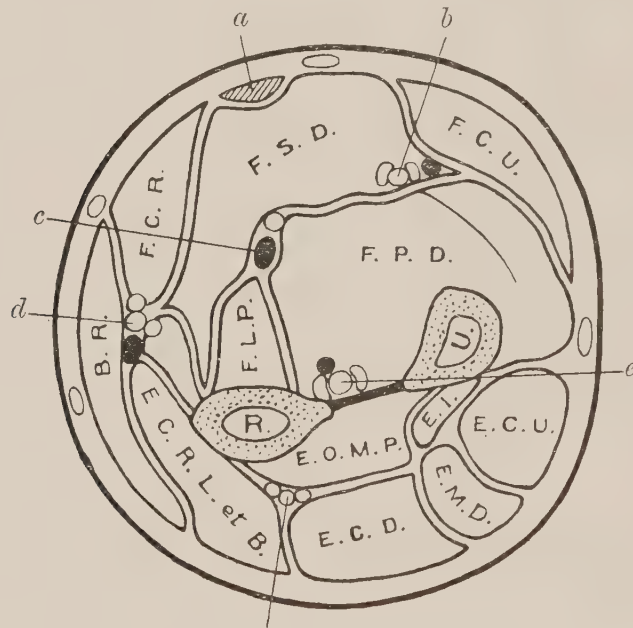
- IV. NERVES —Musculo - cutaneous, median (with brachial vessels), musculo-spiral (with superior profunda vessels), ulnar (with inferior profunda vessels), and internal cutaneous.

Describe Disarticulation at the Elbow Joint.

The circular method (Miller) is the best. The incision is carried round the limb three finger's breadth below the

external epicondyle, but only two finger's breadth below the internal epicondyle; this allows for the greater retraction of the muscles on the outer side. Keep the forearm supinated and the elbow fully extended while making the incision. Separate the brachialis anticus from the coronoid process, the biceps from the radius, and the triceps from the olecranon. Divide the ligaments in order, entering the joint from the outer side.

Fig. 19.—TRANSVERSE SECTION THROUGH RIGHT FOREARM.
(From Whittaker).



a, Palmaris longus.

c, Median nerve and artery.

e, Anterior interosseous vessels and nerve.

b, Ulnar vessels and nerve.

d, Radial vessels and nerve.

f, Posterior interosseous vessels.

What are the Structures Divided?

I. MUSCLES—Biceps, brachialis anticus, pronator radii teres, flexors of fingers and wrist, triceps, anconeus, supinator longus, supinator brevis, extensors of fingers and wrist.

II. VESSELS—Cephalic and basilic veins; radial and ulnar arteries with their recurrent branches.

III. NERVES—Median, ulnar, radial, and posterior interosseous.

What are the Points to remember in Amputating through the Forearm ?

(a) The lower third of the forearm is cylindrical in shape, while the upper two-thirds are cone-shaped ; the circular method can therefore be employed in the lower third, while flaps are used in the remaining two-thirds. These flaps are generally made equal in length.

(b) Secure as long a stump as possible.

(c) Endeavour to preserve the insertion of the pronator teres, else the stump will be permanently supinated.

(d) Saw the bones with the forearm fully supinated, and complete the division of the radius before that of the ulna.

(e) After operation support the stump in a position midway between pronation and supination until the wound is healed.

What are the Structures Divided in Amputating through the Forearm ?

I. MUSCLES—These will vary slightly at different levels. In the upper third the pronator teres will be divided, while near the wrist the pronator quadratus and the extensor indicis would be cut. Generally, the surgeon has to divide the palmaris longus, the flexors of the wrist and fingers, the supinator longus, the extensors of the wrist and fingers, the flexor and the extensors of the thumb.

II. VESSELS—(a) The radial on the inner aspect of the supinator longus.

(b) The ulnar under cover of the flexor carpi ulnaris.

(c) The anterior interosseous on the interosseous membrane.

(d) The small artery accompanying the median nerve.

- (e) The posterior interosseous between the superficial and deep extensors.
- (f) The cephalic and basilic veins.

III. NERVES —Radial, ulnar, median, anterior interosseous, and the posterior interosseous.

Describe Disarticulation at the Wrist.

The main object of disarticulation at the wrist is to conserve pronation and supination; accordingly if the triangular fibro-cartilage of the wrist is diseased, it is preferable to amputate through the lower third of the forearm. Control hæmorrhage by a tourniquet round the upper arm. The simplest method is by means of a long palmar flap. The steps are :—

(1) With the forearm supinated, a palmar flap is outlined, the base corresponding to the tips of the styloid processes; the flap extends to a point just below the level of the outstretched thumb. Dissect up the flap off the long flexor tendons; it consists of skin and fasciæ, palmaris brevis, portions of the thenar and hypothenar musculature, the superficial palmar arch, and the pisiform bone.

(2) Pronate the hand, and make an incision, slightly convex downwards, across the dorsum of the wrist, connecting the two ends of the palmar flap.

(3) Deepen the dorsal incision down to the bone, *i.e.* divide all the extensor tendons, having previously strongly flexed the wrist.

(4) Introduce the knife between the forearm and the carpus, and separate the hand by dividing the lateral ligaments and the flexor tendons.

(5) Secure the vessels, shorten the nerves, snip off the tips of the styloid processes, stitch the flexor and extensor tendons to each other over the end of the stump, and introduce a drainage tube.

What are the Structures Divided?

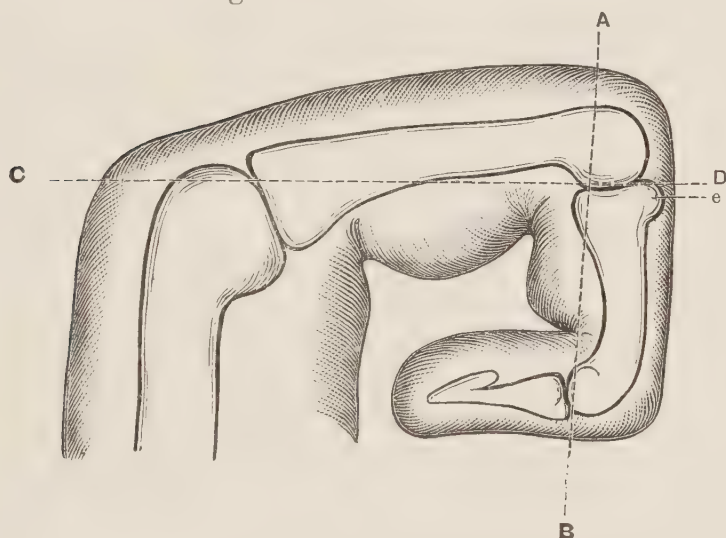
I. MUSCLES—Palmaris longus, flexors of the wrist and fingers, supinator longus, ex-

tensors of the wrist and fingers, the flexor and the extensors of the thumb.

II. VESSELS —Digital branches of the superficial palmar arch, radial, and profunda branch of ulnar.

III. NERVES —Median, ulnar, radial and musculo-cutaneous.

Fig. 20.—BENT FINGER.



A B and C D—Lines showing how to find the joints between the phalanges.
e—Tubercle at the base of the second phalanx, which may be taken as the guide to that articulation.

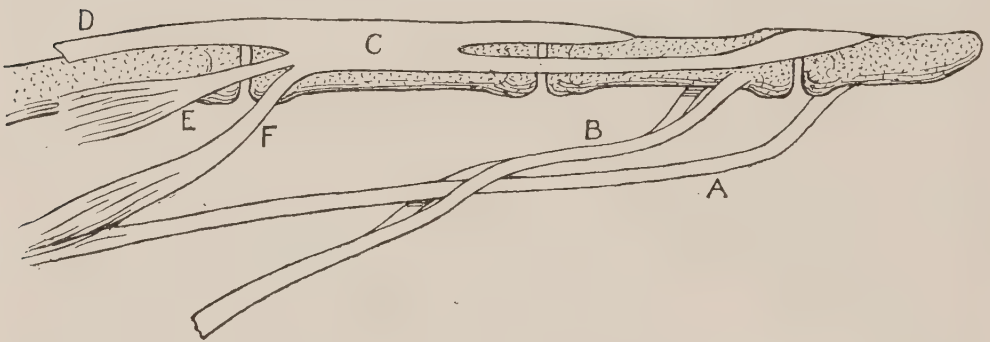
What Anatomical Facts have to be borne in mind when Amputating a Digit?

- (a) The joint-lines lie distal to the “knuckles.”
- (b) The main digital vessels and nerves are nearer the palmar than the dorsal aspect.
- (c) The tendon of the extensor communis digitorum replaces the dorsal ligaments of the interphalangeal joints.
- (d) The tendon of the flexor profundus digitorum is inserted into the base of the terminal phalanx, and the flexor sublimis digitorum into the sides of the second phalanx of each finger.

What Surgical Points have to be attended to when Amputating a Phalanx ?

- (a) Amputation is preferable to disarticulation, *i.e.* it is better to remove the parts by sawing through the base of the phalanx than by going through the joint.
- (b) Where disarticulation has to be performed, the flexor and extensor tendons should be stitched to one another over the face of the stump.

Fig. 21.—THE TENDONS OF THE FINGER (Diagrammatic)



A. Flexor profundus digitorum.
B. Flexor sublimis digitorum.
C. Common extensor expansion.

D. Extensor communis digitorum.
E. Dorsal interosseous.
F. Lumbrical.

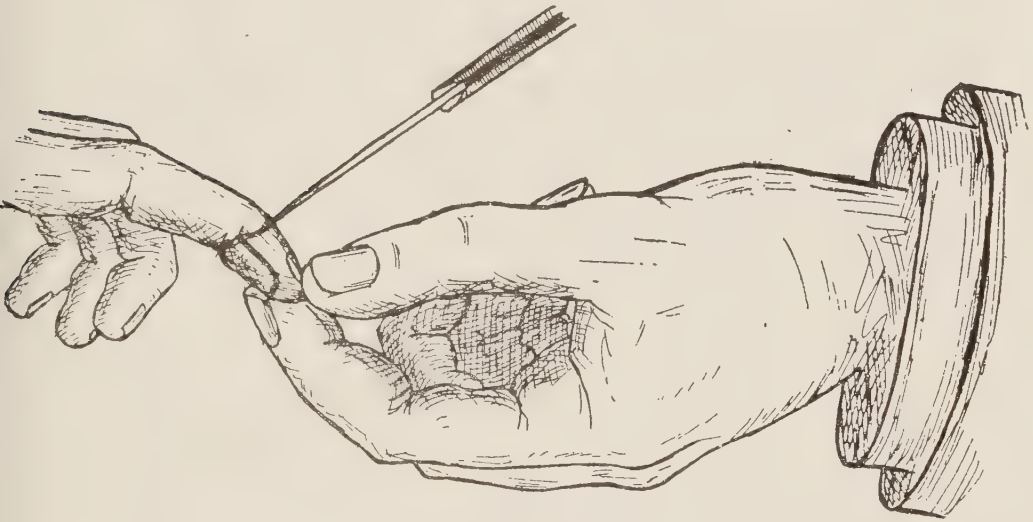
- (c) Carefully stitch up any tendon-sheaths which have been opened.
- (d) As much as possible of the thumb must be preserved. Any removal of bone should be done subperiosteally.
- (e) The cicatrix should be on the dorsum so as to escape pressure.

How would you Remove a Finger at the Metacarpophalangeal Joint ?

Make a racket-shaped incision, the handle commencing on the dorsum just above the centre of the joint and extending downwards to the level of the web. The incision is carried round the finger just below the junction of the web with the palm. Deepen the lateral parts of

the incision down to the bone. Next cut the flexor sheath with its contained tendons and the glenoid ligament. Lastly, complete the disarticulation by severing the extensor tendons and the lateral ligaments. When it is necessary to excise the head of the metacarpal bone the vertical part of the incision should be prolonged upwards for about an inch; an additional structure must also be divided, namely, the transverse metacarpal ligament.

Fig. 23.—AMPUTATION OF A TERMINAL PHALANX.



What Structures are Divided?

- I. MUSCLES—Flexor sublimis digitorum, flexor profundus digitorum, extensor communis digitorum, interossei, a lumbrical, and the digital sheath.
- II, LIGAMENTS—Glenoid, lateral, and dorsal.
- III. VESSELS AND NERVES—Digital.

Give another Method for Amputating a Finger.

Chiene's method by a single palmar flap has many advantages over the racket method, for it—

- (a) Preserves the full breadth of the hand.
- (b) Avoids a cicatrix in the palm.
- (c) Provides a good covering for the head of the meta-

carpal bone. Enter the knife over the prominence of the knuckle and cut on each side towards the web about half-way round the root of the finger. Now carry two lateral incisions down the sides of the finger as far as the first interphalangeal crease, and join them across the palmar surface of the crease. Dissect up the flap of superficial tissues and divide the tendons close to the base of the flap. Disarticulate by dividing the ligaments of the joint.

How would you Amputate a Terminal Phalanx ?

As already mentioned, amputation is preferable to disarticulation. Hold the part to be removed between the left forefinger and the thumb, bend it to a right angle with the second phalanx and make a semilunar incision on the dorsal aspect dividing the superficial tissues and the extensor tendon. Snip across the bone, then lay the knife horizontally behind the phalanx and make a rectangular flap on the palmar surface by cutting from within outwards.

INFERIOR EXTREMITY.

Mention some of the Methods adopted for controlling Hæmorrhage in Disarticulation of the Hip.

(a) Preliminary ligation of the femoral vessels—this method is employed in the anterior racket operation.

(b) Spence's skewer—transfix the thigh well behind the femoral vessels about the level of the great trochanter. One piece of rubber-tubing is applied in a figure-of-eight manner across the front of the thigh, and another over the posterior aspect.

(c) Wyeth's pins—these are introduced through the muscles on the inner and outer sides of the thigh, so that their points emerge near the tuber ischii and the great trochanter respectively. Wrap elastic tubing around the thigh *above* the pins.

(d) Jordan-Lloyd's method—Pass an elastic band between the anus and the tuber ischii and tie the ends over a pad covering the external iliac artery of the same side.

Fig 22.—AMPUTATION AT THE METACARPO-PHALANGEAL JOINT.



Describe Furneaux-Jordan's Amputation at the Hip.

Esmarch's modification of the operation is usually performed. The steps are :—

(i) A circular incision is made round the thigh about five inches below the great trochanter. Dissect up a cuff of skin and subcutaneous tissue for a couple of inches, then divide the muscles, strip them up for a short distance, then cut the periosteum and saw through the femur.

(ii) Secure the main blood-vessels.

(iii) Convert the circular incision into a racket, the handle passing along the outer side of the limb to a point midway between the great trochanter and the iliac crest.

(iv) Separate the muscles from the great trochanter and the outer part of the shaft, the assistant rotating the stump as required.

(v) Open the joint by cutting the capsule and the cotyloid ligaments ; sever the ligamentum teres.

(vi) Disarticulate ; divide the ilio-psoas and the muscles on the inner aspect of the bone.

Notes.—(a) The division of the muscles attached to the trochanters and the disarticulation of the femur should be carried out by means of a short, strong knife, such as Syme's ankle knife. (b) Before cutting the anterior crural and the great sciatic nerves they should be "blocked" by injecting a solution of novocain into them. (c) As far as possible remove the muscles subperiosteally.

Describe the Anterior Racket Method of Amputation at the Hip.

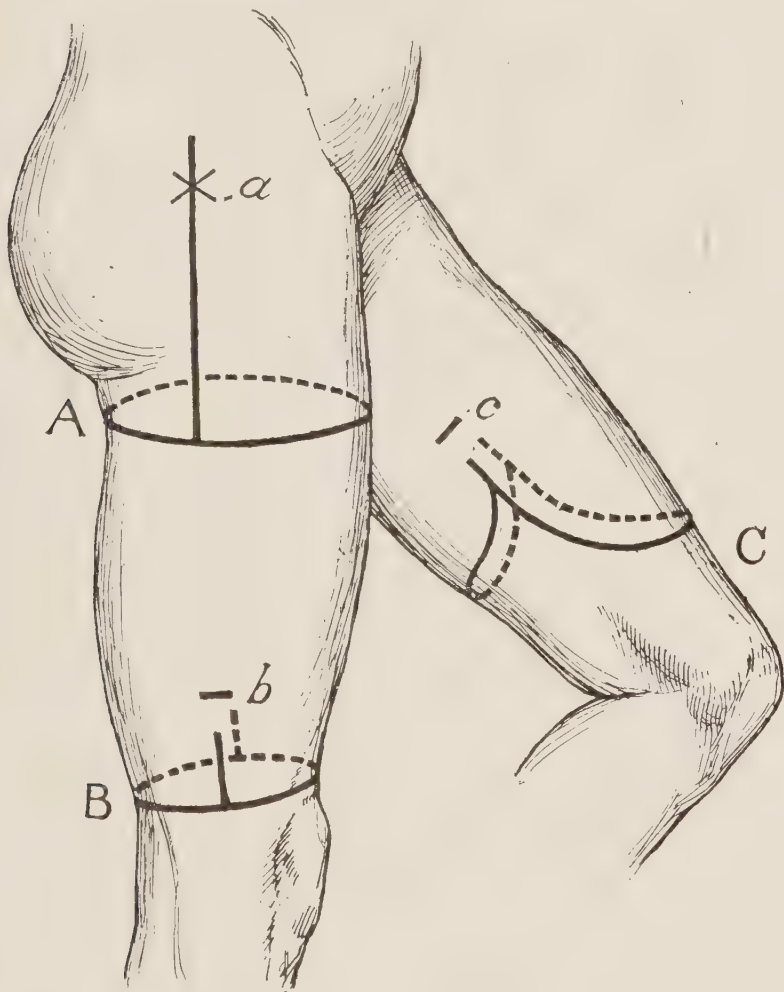
The steps of the operation are :—

(i) Make a vertical incision three inches long from the inguinal ligament along the line of the femoral artery. Carry the incision obliquely down the inner side of the thigh to a point four or five inches below the genito-femoral fold. It then extends across the back of the limb and up over the outer aspect to meet the handle of the racket. The incision is made a little lower on the inner than on the outer side.

(ii) Dissect down to the femoral vessels, ligate them, “block” the anterior crural nerve with novocain, and then divide it.

(iii) Divide the muscles in front of the thigh and open the joint.

Fig. 24.—AMPUTATIONS OF THE THIGH.



A. Disarticulation at Hip by FURNEAUX-JORDAN'S Method. The \times at a shows position of tip of Great Trochanter.

B. Amputation through Lower Third of Thigh—Modified Circular Method.

C. Amputation through Middle Third of Thigh by long anterior and short posterior flaps— b and c indicate point of section of bone.

(iv) Divide the remaining muscles, securing the blood vessels as they are encountered. “Block” the great sciatic nerve before division.

Note.—Whenever possible saw through the neck of the femur instead of disarticulating at the hip.

Name the Structures divided in Amputation at the Hip.

MUSCLES—Pectineus, the three adductors, gracilis, sartorius, tensor fasciæ femoris, quadriceps extensor, obturator internus, gemelli, obturator externus, piriformis, biceps, semimembranosus, semitendinosus, the glutei, quadratus femoris, and the ilio-psoas.

VESSELS—Femoral, profunda, external and internal circumflex, gluteal and sciatic, first perforating branch of profunda, and internal saphena vein.

NERVES—Femoral, obturator, great sciatic, external cutaneous, and small sciatic.

Describe Amputation through the Middle Third of the Thigh.

Lister's method, by a long anterior and a short posterior flap, can be employed. The chief steps are :—

- (a) Make internal and external incisions, each equal to the diameter of the limb, from a little below the site of division of bone.
- (b) Join the ends across the front of the thigh, forming a square-shaped flap with well-rounded angles.
- (c) Shape the posterior flap, making it half the length of the anterior.
- (d) Allow the skin to retract, and divide the muscles obliquely so that the main mass of muscle is towards the base of each flap.
- (e) Clear the bone, saw across, and trim off any sharp edges.
- (f) Secure the vessels, the main ones should lie in the posterior flap.
- (g) With catgut stitches approximate the muscles in the flap so as to obliterate any dead spaces.

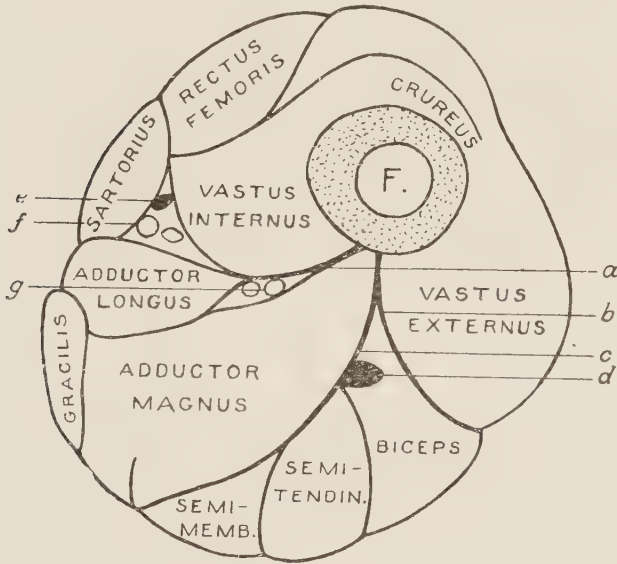
Name the Structures Divided.

MUSCLES—Quadriceps extensor, sartorius, adductor longus, adductor magnus, gracilis, biceps, semitendinosus, and semimembranosus.

VESSELS — Femoral, profunda and perforating branches, descending branch of external circumflex, comes nervi ischiadici, and internal saphenous vein.

NERVES — Great sciatic, obturator, femoral, small sciatic, and external cutaneous.

Fig. 25.—TRANSVERSE SECTION THROUGH MIDDLE OF LEFT THIGH (FROM WHITTAKER).



a, Internal Intermuscular Septum.
b, External Intermuscular Septum.
c, Posterior Intermuscular Septum.
d, Great Sciatic Nerve.

e, Internal Saphenous Nerve.
f, Femoral Vessels.
g, Profunda Vessels.

How would you Amputate in the Lower Third of the Thigh ?

Spence's method is very suitable here. The steps are :—

- (a) Commence the incision well towards the posterior part of the limb and about a hand's breadth above the upper border of the patella. Outline a broad square-shaped flap going down to the lower edge of the patella.
- (b) Dissect up the flap from off the patella and front of the knee-joint; at the upper edge of the patella cut deeply and obliquely towards the femur.

- (c) Apply the edge of the knife to the skin on the posterior aspect, about three inches below the base of the anterior flap, forming a convex flap, and divide the tissues obliquely to the bone.
- (d) Retract the soft parts carefully, clear and saw the femur about two inches higher up than the base of the flaps. At this stage the assistant elevates the leg so as to project the bone as far as possible. When the bone is divided all retraction of the soft parts must be avoided lest the periosteum be stripped off the bone. This caution is especially important in the case of children. The main vessels are in the posterior flap.

Describe Disarticulation at the Knee-Joint.

Miller's method is the best one to adopt. The steps are :—

- (a) Make a circular incision round the leg a hand's breadth below the level of the joint. Dissect up a cuff of skin and fasciæ until the ligamentum patellæ is reached.
- (b) Divide the ligamentum patellæ and the capsule, thus entering the joint.
- (c) Flex the knee and introduce the knife between the tibia and the semilunar cartilages dividing the coronary ligaments and the synovial membrane.
- (d) Flex the joint to a right angle and sever the lateral and crucial ligaments.
- (e) Divide the vessels, nerves, and muscles in the popliteal space.
- (f) The cicatrix is ultimately drawn upwards behind the condyles of the femur and the patella occupies the intercondylar notch.

What Structures are Divided ?

MUSCLES —Biceps, semimembranosus, semitendinosus, gastrocnemius, plantaris, gracilis and sartorius.

LIGAMENTS—Ligamentum patellæ, capsule, coronary, crucial, lateral, and posterior.

VESSELS —Popliteal, and its lower articular branches, saphena veins.

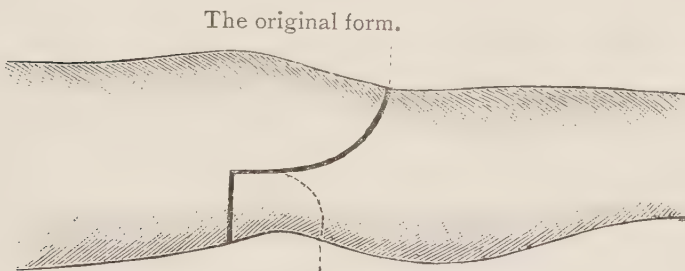
NERVES —Internal and external popliteal.

Give the Details of Carden's Amputation.

This is a transcondyloid amputation of the thigh with removal of the patella. The steps are :—

- (a) Commence the incision immediately above and behind the femoral epicondyles and mark out a broad anterior flap extending down to the

Fig. 26.—CARDEN'S AMPUTATION.



The present form with Posterior Flap.

tubercle of the tibia. The lower angles of the incision should be well rounded.

- (b) Dissect up the flap off the patella and open the joint by dividing the quadriceps extensor, the knee being forcibly flexed before the muscle is cut.
- (c) Separate the soft parts upwards to the level of the adductor tubercle.
- (d) Divide the crucial and the lateral ligaments.
- (e) Extend the limb and dissect up a posterior flap one half the length of the anterior one.
- (f) Saw the bone immediately below the adductor tubercle.

Describe Ssabanejeff's Amputation.

This is an osteoplastic transcondyloid amputation, and is said to give excellent results. It is carried out as follows :—

- (a) An anterior flap is outlined as in Carden's amputation, but is carried down a little below the tuberosity of the tibia.
- (b) Dissect up the flap as far as the lower edge of the patella, then saw off a pyramidal portion of the tibia, starting just below the tibial tuberosity and carrying the saw obliquely upwards as high as the head of the fibula.
- (c) Divide the capsule and the lateral ligaments, and reflect up the anterior flap along with the piece of bone.
- (d) Saw through the femoral condyles downwards and backwards.
- (e) Divide the vessels, nerves, and soft parts behind in a transverse manner at the level of the joint.
- (f) The separated portion of the tibia is applied to the sawn surface of the femur.

The advantages of Ssabanejeff's amputation are :—

- (i) the skin and bone of the anterior flap are accustomed to bear pressure, and (ii) the sartorius, gracilis, semi-membranosus, and biceps expansion are preserved.

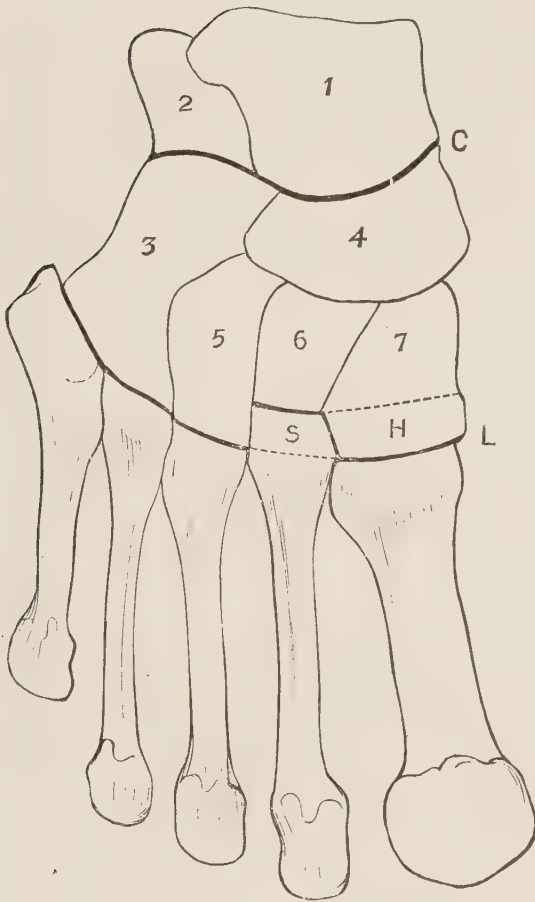
Describe Gritti-Stokes' Amputation.

Gritti-Stokes' method is an osteoplastic supracondyloid amputation. Proceed thus :—

- (a) Make anterior and posterior flaps as in Carden's amputation, but commence half an inch higher up the limb.
- (b) Dissect up the anterior flap until the ligamentum patellæ is reached, cut this and open the joint.
- (c) Divide the capsule freely, also the cruciate and lateral ligaments, flexing strongly during the procedure.
- (d) Extend the limb, and cut out the posterior flap.

- (e) Clear the femur, and saw the bone half an inch above the adductor tubercle.
- (f) Saw off the articular surface of the patella.
- (g) Fix the patella to the sawn surface of the femur, either by stitching the periosteum or by introducing a nail. The latter should be removed two or three weeks later.

Fig. 27.—TARSUS AND METATARSUS.



- 1. Astragalus.
- 2. Os Calcis.
- 3. Cuboid.
- 4. Scaphoid.
- 5, 6, 7, Cuneiforms.
- C. Line of CHOPART'S Amputation.
- L. Line of LISFRANC'S Amputation.
- H. Part of the Internal Cuneiform removed by HEY.

How is Amputation performed at the Upper Third of the Leg?

Farabœuf's antero-external flap can be employed. The incision is U-shaped, and commences a hand's breadth below the level of the knee-joint. The anterior limb of the U is carried down close to the inner border of

the tibia for a distance equal to the diameter of the limb at the point of section of the bone. The posterior limb of the U runs up the middle of the calf, and stops one and a half inches short of the level at which the anterior limb commenced. On the inner side of the leg a horizontal incision connects the upper extremity of the posterior limb to the anterior limb. The antero-external flap contains all the structures down to the bone. Divide the fibula at a higher level than the tibia.

Describe an Osteoplastic Amputation through the Leg.

An antero-internal (Bunge) or antero-external (Kocher) skin flap is dissected up, the centre of the flap corresponding to the internal surface of the tibia. Divide the periosteum transversely at the level of the apex of the flap. Make two lateral incisions through the periosteum of sufficient length to reach across the tibia; these incisions should be placed just behind the anterior and internal borders of the tibia. Strip up the periosteum for a short distance and remove a small wedge from the bare surface of the bone. With a Gigli or a frame-saw remove a layer of bone subjacent to the flap of periosteum. Break across the layer of bone at its base, strip up the periosteum a little further, and divide the soft parts circularly. Saw across the bones, dividing the fibula at a higher level than the tibia, and suture the osseous flap over the cut surface of the tibia. Kocher retains the continuity of the osteoplastic flap with the overlying skin.

What Amputations are performed in the region of the Foot and Ankle?

- (a) Removal of a phalanx or a toe.
- (b) Disarticulation at the tarsometatarsal joints (Lisfranc's operation and its modifications.)
- (c) Disarticulation at the midtarsal joint (Chopart's operation).
- (d) Sub-astragaloid disarticulation.
- (e) Disarticulation at the ankle joint, and removal of the malleoli (Syme's and Mackenzie's operations).

(f) Osteoplastic amputation of the foot (Pirogoff's operation).

Describe Lisfranc's Operation.

Two points are taken, one just behind the base of the fifth metatarsal, and the other one inch in front of the tuberosity of the scaphoid. Join these points over the dorsum of the foot by an incision slightly convex for-

Fig. 28.—INCISIONS FOR HEY'S AMPUTATION.



wards. From the starting points carry two lateral incisions as far as the heads of the metatarsals, and connect them at this level on the plantar aspect of the foot.

Give the Subsequent Steps.

(a) Divide the structures upon the dorsum of the foot, the main ones being the tibialis anticus, extensor longus digitorum, peroneus tertius and brevis, extensor brevis digitorum, dorsalis pedis and the digital arteries, anterior tibial and the musculo-cutaneous nerves.

(b) Separate the fifth metatarsal from the cuboid, directing the knife towards the *head* of the first metatarsal.

(c) Separate the fourth metatarsal from the cuboid, pointing the knife towards the *middle* of the first metatarsal.

(d) Disarticulate the third metatarsal from the corresponding cuneiform bone, directing the knife towards the *base* of the first metatarsal.

(e) Saw through the first cuneiform (Hey's modifica-

tion) at the level of the base of the second metatarsal, and separate the latter bone from the second cuneiform.

(f) Forcibly bend the metatarsus towards the sole, pass the knife through the metatarso-phalangeal joints and dissect the metatarsus from the plantar flap, *i.e.* from the long and short flexor tendons, and the small muscles of the toes.

(g) Secure the bleeding vessels, shorten the nerves, and stitch the tendons over the face of the stump. Drain for 36 hours.

Describe Chopart's Amputation.

The two guides are the tuberosity of the scaphoid on the inner side, and a point one inch behind the base of the fifth metatarsal bone on the outer side. A dorsal incision, slightly convex forwards, is made connecting the two guides. A plantar flap is outlined as in Lisfranc's operation but it only extends as far as the middle of the metatarsus. Next bend the foot forcibly downwards and disarticulate. Lastly, separate the plantar flap.

N.B.—Open the astragalo-scaphoid joint first, as its exact relation to the tuberosity is more easily determined.

What is the Chief Objection to Chopart's Amputation?

Owing to the unopposed action of the tendo Achillis, the heel tends to be drawn upwards. To counteract this, stitch the extensor tendons to the dorsal flap.

Mention the Structures Divided.

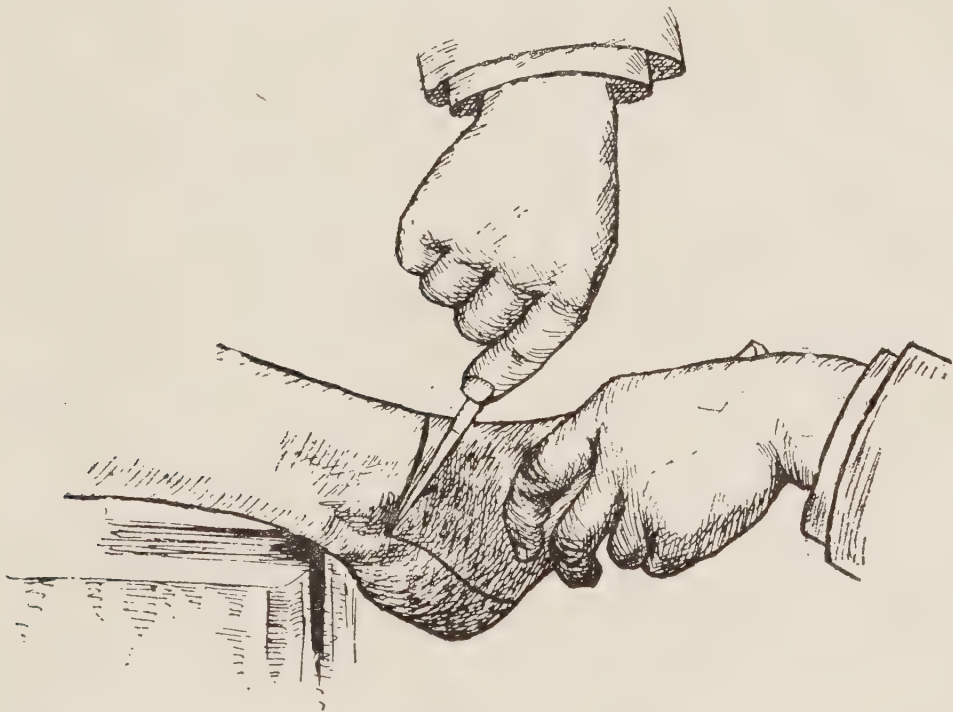
- I. MUSCLES—Tibialis anticus, extensor brevis digitorum, extensor longus digitorum, extensor longus hallucis, peroneus longus, brevis and tertius, tibialis posticus, flexor longus digitorum, flexor longus hallucis, and the intrinsic muscles of the sole.
- II. VESSELS—Internal plantar, external plantar with the plantar arch and its digital branches, dorsalis pedis and its branches, and the dorsal plexus of veins.

III. NERVES— Anterior tibial, plantar nerves, external saphenous, and the musculocutaneous.

Describe Syme's Amputation.

The guides for this operation are the tip of the external malleolus and a point exactly opposite this on the inner side, *i.e.* a point about half-an-inch behind and below the internal malleolus. Unite these points by the shortest road across the dorsum of the foot, and then

Fig. 29.—SYME'S AMPUTATION.



across the sole, sloping the incision slightly backwards. The subsequent steps are :—

- (a) Forcibly depress the foot, open the joint, and divide the lateral ligaments.
- (b) Carefully dissect the bone out of the heel-flap separating the tendo Achillis from the os calcis. Keep the knife close to the bone so as to avoid the internal calcanean artery.
- (c) Clear the articular ends of the tibia and fibula and remove them with the saw ; if they are

not diseased, merely saw off the projecting ends of the malleoli.

(d) Tie the vessels and provide for drainage.

Mention the Structures Divided.

I. MUSCLES—Tendo Achillis, tibialis anticus, extensor longus digitorum, extensor longus [hallucis, peroneus tertius, longus and brevis, tibialis posticus, flexor longus digitorum, flexor longus hallucis, muscles of first layer of sole, and flexor accessorius.

II. VESSELS—Dorsalis pedis or anterior tibial, internal and external plantars, internal and external saphena veins.

III. NERVES —Internal and external saphena, musculo-cutaneous, anterior tibial, and plantars.

How is Pirogoff's Amputation Performed?

This is an osteoplastic amputation in which the posterior part of the os calcis is preserved in the heel-flap, and is adjusted to the cut surface of the tibia and fibula. The incision begins and ends at the same points as in Syme's amputation, but the plantar incision is carried slightly obliquely forwards, and the dorsal incision is made convex forwards. After disarticulating, the os calcis is divided in the line of the plantar incision, and the bones of the leg sawn through just above the malleoli, the saw cut being parallel to the section of the os calcis. Unite the bones, either by stitching the periosteum or by a nail driven up through the middle of the heel-flap.

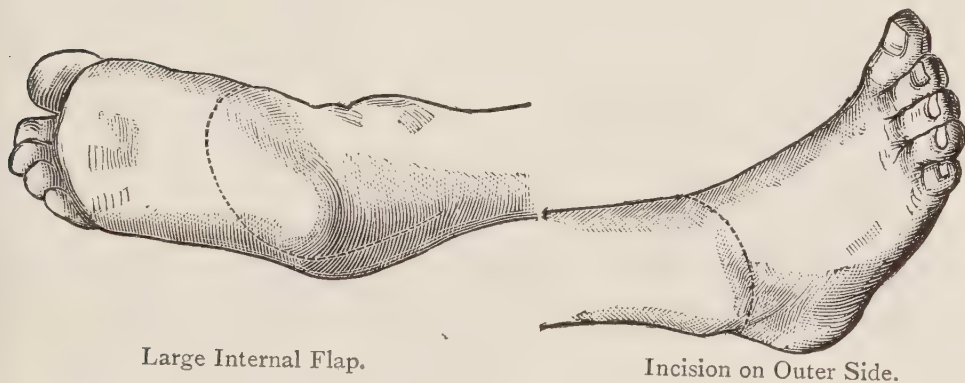
Describe Mackenzie's Amputation.

This is a disarticulation at the ankle by means of a large internal flap. The guides are (a) the centre of the tendo Achillis at the level of the joint, and (b) a point on the tendon of the tibialis anticus, one inch in front of

the internal malleolus. Place the thumb and forefinger on the guides and insert the point of the knife over the centre of the tendo Achillis. Cut obliquely across the tendon towards the outer and plantar aspect of the heel, along which it is continued in a semilunar direction. The incision is then curved upwards in front of the internal malleolus as far as the tibialis anterior. Lastly, a small flap, convex downwards, is made by joining the extremities of the incision just below the external malleolus.

Dissect up the flaps, the internal one going down to the bone so as to include the muscles and vessels. Open the joint, clear the tibia and fibula, and saw the bones as in Syme's amputation.

Figs. 30 and 31.—MACKENZIE'S AMPUTATION.



Large Internal Flap.

Incision on Outer Side.

ADDITIONAL OPERATIONS ON THE EXTREMITIES.

Describe Mayo's Operation for Hallux Valgus.

Make a semilunar incision over the bunion; the convexity of the incision being directed upwards so that the subsequent cicatrix will not be exposed to pressure. Divide the superficial structures and turn the flap downwards thus exposing the bursa. Dissect the bursa from the internal lateral ligament of the joint by a semilunar incision the concavity of which points towards the toes. Cut the ligament and with bone forceps remove the prominent portion of the head of the first metatarsal. Slip the bursa between the bones, securing it with one or two catgut stitches. Suture back the soft parts.

How is Excision of the Astragalus performed ?

This operation may be required for trauma, tuberculosis, or club-foot. Commence the incision a hand's breadth above the ankle and carry it downwards along the anterior surface of the fibula as far as the base of the fifth metatarsal bone. The incision opens the ankle and mid-tarsal joints. Separate the ligamentous connections of the astragalus, namely :—

(a) the dorsal ligament passing to the scaphoid ; (b) the external, posterior, and interosseous ligaments joining it to the os calcis ; (c) the anterior and posterior fasciculi of the external lateral ligament of the ankle ; (d) the anterior and posterior ligaments of the ankle ; and (e) the internal lateral ligament of the ankle.

Describe Excision of the Os Calcis.

The incision passes down the inner border of the tendo Achillis, thence across the back of the heel and along the outer margin of the foot to the base of the fifth metatarsal bone. The subsequent steps are :—

- (a) Detach the tendo Achillis from the posterior surface of the bone, and cut the posterior ligament uniting the os calcis to the astragalus.
- (b) Separate the soft structures from the outer side, first cutting the external annular ligament and hooking the peroneus longus and brevis forwards.
- (c) Divide the middle fasciculus of the external lateral ligament, the external calcaneo-astragaloid ligament, and the origin of the extensor brevis digitorum.
- (d) Cut the dorsal calcaneo-cuboid and the interosseous calcaneo-astragaloid ligaments.
- (e) Separate the soft parts from the under surface of the heel, namely, the plantar fascia, the origin of the muscles of the first layer of the sole, the flexor accessorius and the inferior calcaneo-cuboid ligaments.
- (f) Lastly, divide the internal lateral (deltoid) ligament, the inferior calcaneo-scaphoid liga-

ment, and the tibialis posticus; they are attached to the sustentaculum tali.

How is Excision of the Scapula carried out?

This operation may be performed for severe comminuted fractures or for periosteal sarcoma. An attempt should be made to preserve the acromion process, coracoid process, and glenoid fossa. The subclavian artery should be controlled throughout the operation.

An oblique incision is carried along the spine of the scapula; it is joined by a vertical incision along the vertebral border from the superior to the inferior angle.

STEPS :—

- (i) The two flaps of skin and fasciæ are dissected from the underlying muscles.
- (ii) The trapezius and deltoid are detached from the scapular spine; the acromion process is chiselled through.
- (iii) Next clear the vertebral border, dividing the levator anguli scapulæ, rhomboideus minor and rhomboideus major, from above downwards.
- (iv) Secure the posterior scapular vessels.
- (v) Pull the scapula away from the chest and sever the serratus magnus.
- (vi) Divide the supraspinatus and the posterior belly of the omo-hyoid.
- (vii) Ligate the suprascapular vessels.
- (viii) Cut through the muscles of the inferior angle and axillary border, namely, latissimus dorsi, teres major, and teres minor. Divide the infraspinatus.
- (ix) Tie the subscapular vessels.
- (x) Pass a Gigli saw through the surgical neck of the scapula. The coracoid process and the glenoid fossa are thus left behind, together with their muscles and ligaments.
- (xi) Lastly, divide the subscapularis.
- (xii) Provide for drainage.

How would you expose the Musculo-cutaneous Nerve?

A two-inch incision is made in the external bicipital sulcus commencing at the junction of the middle and lower thirds of the arm. Divide skin and fasciæ avoiding the cephalic vein, and retract the biceps inwards. The nerve will be found lying upon the brachialis anticus muscle.

Describe the Exposure of the Circumflex Nerve.

Make a vertical incision three inches in length along the back of the upper arm, the centre of the incision being placed opposite the junction of the upper and middle thirds of the deltoid muscle. After division of the skin and fasciæ, the deltoid is hooked forwards and the lower border of the teres minor defined. The nerve accompanied by the posterior circumflex artery will be found between the teres minor and the humerus.

Describe the Exposure of the External Cutaneous Nerve.

This nerve may be resected for neuralgia parasthetica. The incision lies half an inch below the anterior superior spine of the ilium, is one inch long, and runs parallel with the inguinal (Poupart's) ligament. The nerve will be found under cover of the fascia lata and along the outer border of the sartorius muscle.

How is the Anterior Crural Nerve exposed.?

Make an incision two inches long, a finger's breadth below the middle of Poupart's ligament. Divide the skin and fasciæ, pulling aside or ligating the superficial epigastric vessels. The nerve will be found after dividing the fascia over the ilio-psoas muscle, lying deeply in the sulcus between the two portions of the muscle.

OPERATIVE TREATMENT OF FRACTURES.

Operative treatment is usually carried out seven to ten days after the injury, by which time the swelling of the soft parts has considerably diminished. The chief points to be attended to are :—

- (a) Disturb the adjacent structures as little as possible.
- (b) Avoid injury to any motor nerves encountered during the operation.
- (c) All the instruments used should possess long handles in order to diminish the risk of infection by the surgeon's hands.
- (d) When accurate coaptation of the broken bones has been attained, they are secured by either silver wire, or metallic plates, screws, - or "medullary" bone pegs.
- (e) Metallic plates (Lane's plates) should be applied to that surface of the bone which has the most ample covering of soft parts.
- (f) In simple fractures the wound should be closed without drainage.

How is Fracture of the Upper End of the Humerus exposed?

An incision is made similar to that employed for excision of the shoulder by the anterior route (*see Part I.*). The cephalic vein is avoided, and the interval between the deltoid and the pectoralis major defined. Retract the deltoid outwards. After securing the fragments together and closing the wound, the limb is kept fully abducted for ten to fourteen days, then the angle is diminished gradually. Should a dislocation of the shoulder-joint be present in addition to the fracture, the dislocation is reduced before the fracture is treated.

Give the Treatment for Fracture of the Humeral Shaft.

Expose the fracture by an incision in the outer bicipital sulcus. Separate the soft parts and carefully examine the musculo-spiral nerve. It may have been torn, or may be embedded in the soft callus. In the latter case gently free it from pressure. Fix the bony fragments together and then, if the nerve has been torn, suture the divided ends. In the subsequent after-treatment keep the hand dorsi-flexed.

Describe Exposure of Fracture of the Lower End of the Humerus.

The incision varies according to the seat of fracture, being made either over an intermuscular septum, or in the middle line behind. Avoid injury to the ulnar, musculo-spiral, and musculo-cutaneous nerves.

How is the Olecranon exposed ?

A U-shaped flap containing the olecranon bursa is dissected downwards from the posterior aspect of the triceps and olecranon. The fragments are identified and brought into apposition. It may be necessary in some cases to lengthen the triceps in order to attain accurate coaptation. Unite the fragments by silver wire, taking care that the wire does not penetrate the articular cartilage.

Give the Treatment for Fracture of the Bones of the Leg.

The bones are exposed by an incision immediately to the outer side of the tibialis anterior. The interval between this muscle and the extensor longus digitorum is opened up and the fragments are cleared. It is only necessary to plate the tibia.

Describe the Operative Treatment for Fracture of the Patella.

Either a vertical, transverse, or U-shaped incision may be employed. In the last method the base of the U should be directed downwards. Separate the fragments and irrigate the joint with saline. Trim the edges off the torn periosteum and wipe the broken surfaces of the bone. The fragments may be secured either with a Lane's special plate, or by silver wire sutures. Pass the sutures in a horizontal manner, and avoid penetrating the articular surface. The torn patellar capsule is repaired with catgut.

How are Fractures of the Femur exposed ?

When the shaft is broken, access is obtained by an incision over the external intermuscular septum, and the

interval between the extensors and the flexors opened up. Fractures of the neck of the femur can be dealt with either subcutaneously or by an anterior incision. In the former method an 8-inch steel nail is introduced through the skin over the great trochanter, and driven through the neck into the head of the femur. If the anterior incision is made, it should be performed as in the anterior route for excision of the hip-joint (*see Part I.*).

HEAD AND NECK.

NERVES.

Describe the Exposure of the Supraorbital Nerve.

The supraorbital is a branch of the ophthalmic division of the trigeminal. Shave the eyebrow and identify the position of the supraorbital notch. It will be found at the junction of the inner and middle thirds of the superior orbital margin. Pull the eyebrow upwards and make a horizontal incision about $\frac{3}{4}$ -inch long, the centre of the incision corresponding to the notch. Divide the orbicularis palpebrarum and the nerve, with its accompanying vessels, will be exposed. Separate the nerve and resect $\frac{1}{2}$ -inch. The central end can be gripped with Kocher's artery forceps and forcibly avulsed.

How is the Infraorbital Nerve exposed?

This is a branch of the maxillary division of the trigeminal nerve. Palpate the infraorbital foramen. It lies a $\frac{1}{4}$ -inch below the middle of the inferior orbital margin. Make a transverse incision about $\frac{3}{4}$ -inch long, slightly convex downwards, over the foramen. Cut through the orbicularis palpebrarum and recognise the nerve issuing from the foramen. Separate the nerve from the vessels and resect as in the case of the supraorbital. Subsequently the foramen may be blocked with a small quantity of silver amalgam (Mayo).

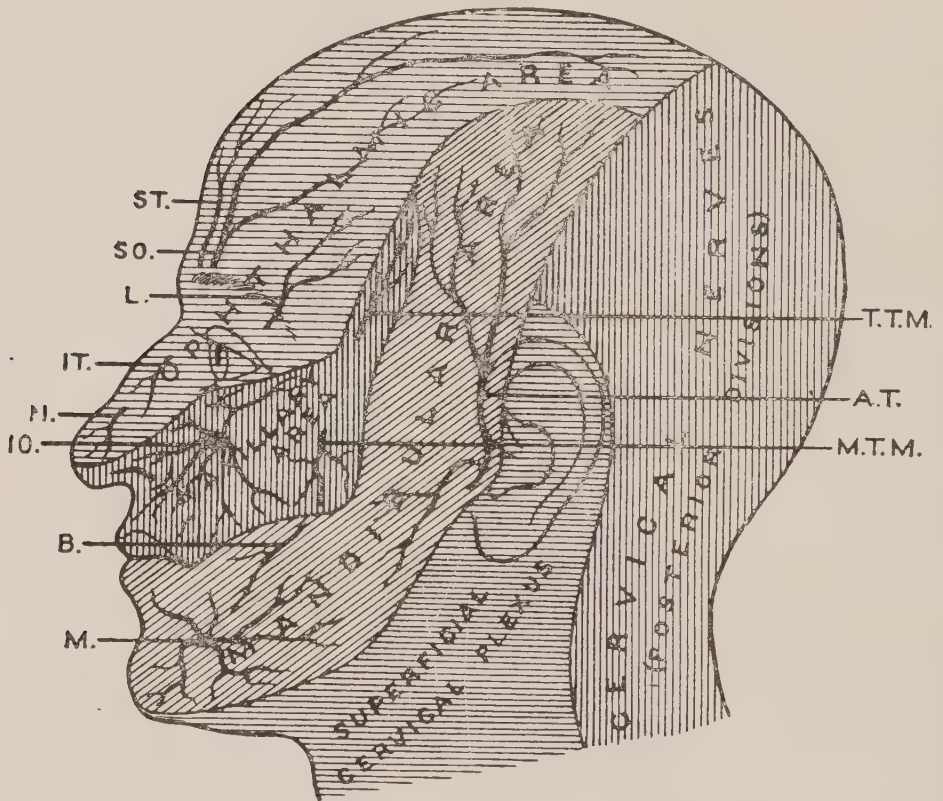
Describe the Exposure of the Mental Nerve.

The mental nerve is derived from the inferior dental branch of the mandibular division of the trigeminal. The

mental foramen will be found on the outer surface of the mandible below the interval between the premolar teeth. A line projected through the supraorbital and infraorbital foramina passes over the mental foramen.

Displace the lower lip downwards and make a small horizontal incision over the foramen, in the line of re-

Fig. 32.—THE SENSORY AREAS OF THE HEAD.
(After GERRISH and TESTUT.)



ST. Supra-trochlear.
SO. Supra-orbital.
L. Lacrimal.
IT. Infra-trochlear.

N. Nasal.
IO. Infra-orbital.
B. Buccal.
M. Mental.

T.T.M. Temporal Branch of
Temporo-malar.
A.T. Auriculo-temporal.
M.T.M. Malar Branch of
Temporo-malar

flection of the mucous membrane from the lip to the gum. Deepen this incision until the nerve becomes visible. Treat as in the case of the infraorbital.

Give a method of exposing the Inferior Dental Nerve.

The inferior dental is a branch of the mandibular division of the trigeminal. Before entering the inferior

dental canal it gives off a motor twig which supplies the mylo-hyoid and the anterior belly of the digastric. The inferior dental can be exposed intrabuccally or by an external incision.

By an external incision.

Transmandibular neurectomy. Make a curved incision just behind the angle of the mandible ; avoid the facial nerve above and the facial vessels in front. Dissect carefully downwards until the masseter is exposed. Separate this muscle subperiosteally, and apply a $\frac{1}{2}$ -inch trephine midway between the wisdom tooth (or the root of the coronoid process), and the angle of the jaw. On removing the external table, the nerve will be laid bare. Seize it with forceps and resect as much as possible, subsequently packing the canal with amalgam or hard paraffin.

By an internal incision.

Intrabuccal neurectomy. After gagging open the mouth and retracting the tongue to the opposite side, a vertical incision about one inch long is made through the muco-periosteum, immediately behind the anterior edge of the ascending ramus of the mandible. Separate the muco-periosteum until the internal lateral ligament is reached. Carefully divide this ligament and hook up the nerve and vessels. Clear the nerve and resect about half-an-inch.

How is the Lingual Nerve exposed ?

As before, gag open the mouth and retract the tongue. Identify the wisdom tooth, or the root of the coronoid process, and divide the mucous membrane at a point three quarters of an inch below and behind this landmark. The nerve can be immediately hooked up with an aneurysm needle and a portion resected.

Describe the Resection of the Auriculo-temporal Nerve.

Like the inferior dental and lingual nerves, the auriculo-temporal takes origin from the mandibular division of the

trigeminal. To expose it make a small vertical incision immediately anterior to the tragus. The superficial temporal vessels will be encountered, and the nerve lies posterior to the vessels. Resect about half an inch of the nerve.

Give the steps of Extra-cranial Neurectomy of the Mandibular Division of the Trigeminal.

The mandibular division leaves the cranial cavity *via* the foramen ovale. The nerve is connected with the otic ganglion through the nerve to the internal pterygoid.

- (a) Commence the incision half an inch above the external angular process of the frontal bone, carry it downwards to the zygoma, thence along the zygoma, and upwards in front of the ear to just above the summit of the lobule.
- (b) Dissect up this flap of integument and superficial temporal fascia ; secure the superficial temporal vessels.
- (c) Divide each end of the zygoma and displace it downwards along with the masseter.
- (d) Snip off the coronoid process and push it upwards with the temporal muscle, or leave the coronoid intact and draw the muscle forwards.
- (e) Separate the external pterygoid from the under surface of the great wing of the sphenoid.
- (f) The nerve will be seen issuing from the foramen ovale. Hook it up with an aneurysm needle and resect as much as possible. Replace the zygoma.

Describe Extra-cranial Neurectomy of the Maxillary Division of the Trigeminal,

This division leaves the cranium at the foramen rotundum, traverses the spheno-maxillary fossa, and enters the orbit through the spheno-maxillary fissure. As the infra-orbital it occupies the infraorbital canal and emerges at the infraorbital foramen. The steps of the operation are :—

- (a) The incision commences half an inch internal to

the infraorbital foramen, passes just beneath the lower margin of the orbit, and extends on to the zygoma. It is thus slightly convex downwards.

- (b) After dividing the superficial structures, deepen the incision through the orbicularis palpebrarum until the infraorbital vessels and nerve are exposed.
- (c) Pass a needle beneath the nerve and carefully hold it aside while the bone is being chiselled through.
- (d) Separate the soft parts from the malar bone, and elevate the orbital periosteum as far as the speno-maxillary fissure.
- (e) The malar bone is then resected temporarily by chiselling through the malar process of the superior maxilla, then by chiselling downwards and backwards from the fronto-malar suture into the speno-maxillary fissure, and lastly by dividing the zygoma at its inner end.
- (f) Displace the malar bone upwards and outwards, follow the infraorbital nerve backwards, and avulse it by Thiersch's method.
- (g) Replace the zygoma, suturing the soft parts again.

Describe the Intracranial Exposure of the Second and Third Divisions of the Trigeminal.

This is usually termed the Abbé operation. Make a vertical incision in the temporal fossa down to the zygoma. Divide the skin and superficial temporal fascia, and ligate the superficial temporal vessels. In order, divide the deep temporal fascia, temporal muscle, and periosteum; the deep temporal artery may require tying. Apply a 1-inch trephine and remove the disc of bone, subsequently enlarging the opening with rongeur forceps. Secure the middle meningeal artery. Elevate the dura mater cautiously from the base of the middle fossa until the third division is seen. Divide this, and lift up the dura a little farther until the second division is encountered.

The second division is cut, and a piece of sterilised rubber is inserted between the severed nerves to prevent subsequent reunion. Mayo achieves the same purpose by interposing a small metallic plate which covers both the foramen ovale and the foramen rotundum.

How is the Semilunar (Gasserian) Ganglion removed?

The method practised by Harvey Cushing will be described. The operation is a very formidable one, so the patient must be carefully prepared beforehand. The corresponding half of the head is shaved, and the external auditory meatus, after sterilisation, is packed. Some surgeons advocate a preliminary ligature of the external carotid artery. The subsequent stages are :—

- (a) Commence the incision at the zygoma just anterior to the tragus, carry it vertically upwards to immediately above the summit of the ear, then horizontally forwards to the external angular process, and lastly vertically downwards to the zygoma. The reversed U-shaped flap, consisting of skin and superficial temporal fascia, is dissected downwards and the superficial temporal vessels ligated.
- (b) The zygoma is divided at its two extremities and displaced downwards along with the masseter muscle.
- (c) The coronoid process of the mandible is snipped off in order to pull the temporal upwards.
- (d) Separate the external pterygoid from the sphenoid until the infra-temporal crest can be palpated.
- (e) Trephine through the cranium with a 1-inch trephine, placing the pin as near as possible to the infra-temporal crest. Enlarge the opening with forceps until it is about one and a half inches in diameter. Draw the middle meningeal artery backwards.
- (f) Elevate the dura carefully, checking the venous oozing with warm saline and adrenalin, until the mandibular branch is reached; it is divided.

- (g) The dura is then elevated until the maxillary branch can be divided.
- (h) The two divisions are traced backwards to the cavum Meckelii; this is opened on its under surface and the ganglion torn out. Care must be taken not to injure the cavernous sinus or the internal carotid artery.

Describe the Exposure of the Spinal Accessory Nerve.

The spinal accessory is often divided for the condition known as spasmodic torticollis. In addition, the posterior primary divisions of the first four or five cervical nerves are resected *on the opposite side*. To expose the spinal accessory a vertical or an oblique incision may be used. In the former case it commences at the mastoid process and runs downwards along the anterior border of the sterno-mastoid for about two and a half inches. The further steps are:—

- (a) Divide the superficial structures, avoiding or tying the external jugular vein. Retract the sterno-mastoid backwards.
- (b) Identify the posterior belly of the digastric; displace it upwards.
- (c) In the angle between the digastric and the sternomastoid palpate the transverse process of the atlas. The occipital artery runs above the process and the spinal accessory nerve below it.
- (d) Crossing the nerve is the small artery to the sterno-mastoid from the occipital; tie it.
- (e) Excise about half an inch of the nerve.
- (f) Suture and dress the wound.

How would you expose the Facial Nerve?

An incision one inch long and slightly convex downwards is made half an inch below the lobule of the ear. The parotid is displaced forwards and the posterior belly of the digastric defined; the facial nerve will be found along its upper border. Pass an aneurysm needle round the nerve, and apply gentle traction. This operation is undertaken for facial (histrionic) spasm.

Give the Steps used in Facio-hypoglossal Anastomosis.

The *hypoglossal* nerve leaves the cranium through the anterior condyloid foramen. It enters the neck behind the internal jugular vein and the internal carotid artery. It next passes downwards between the internal carotid and the internal jugular, going beneath the posterior belly of the digastric and the stylohyoid. After looking round the occipital artery it crosses the external carotid and the first part of the lingual to enter the submaxillary triangle beneath the intermediate tendon of the digastric. In this triangle the nerve disappears under the mylohyoid, resting upon the hypoglossus just below Wharton's duct, and reaches the tongue lying internal to the lingual artery. The *facial* nerve emerges from the stylo-mastoid foramen, enters the parotid gland along the upper border of the posterior belly of the digastric, and crosses the mandible on a level with the lower edge of the tragus. It divides into two divisions, temporo-facial and cervico-facial.

- (a) The incision for anastomosis runs from the anterior border of the mastoid process obliquely downwards and forwards to the great cornu of the hyoid.
- (b) Divide the superficial structures, tying the external and anterior jugular veins.
- (c) Retract the sterno-mastoid and expose the posterior belly of the digastric; pull this muscle downwards and displace the parotid upwards.
- (d) Pull aside or ligate,, the posterior auricular vessels, and trace the facial nerve backwards to the stylo-mastoid foramen. Pass an aneurysm needle round the nerve.
- (e) Displace the digastric upwards; the occipital artery will be found along its lower border. Follow the artery until the hypoglossal nerve is seen hooking round it.
- (f) Divide the facial at the stylo-mastoid foramen, and divide the hypoglossal one-third through. Implant the distal end of the facial into the cut made in the hypoglossal. Suture carefully,

and implant into the digastric so as to prevent cicatricial tissue forming over the line of suture.

The two great essentials for the successful anastomosis are (i.) strict asepsis and (ii.) absence of tension.

OPERATIONS ON THE CRANIUM.

Describe Schwartz's Operation on the Mastoid Antrum.

This operation is performed for acute mastoiditis. The incision runs parallel with the posterior attachment of the pinna, and lies a little less than half an inch behind it. Deepen the incision to bone; the mastoid emissary vein is often encountered. Detach the pinna forwards until the posterior part of the external auditory meatus and the suprameatal fossa are exposed. The floor of this fossa forms the outer wall of the mastoid antrum. The fossa is limited above by the suprameatal crest; below by the suprameatal spine; and behind by a tangent drawn upwards from the posterior wall of the meatus. With a mastoid chisel open the antrum through this triangle working downwards, forwards, and inwards. Keep within the limits of the triangle, for the middle cranial fossa will be opened if the operator goes above the crest, and the sigmoid portion of the transverse (lateral) sinus endangered if the bone is injured behind the tangent. The antrum will be reached at a distance of from a quarter to half an inch from the surface.

The opening into the antrum should be made somewhat funnel-shaped, the wide part being to the outer side. After the antrum has been broken into, the interior is scraped out with a small spoon; this removes all the mucoperiosteum, granulation tissue, and carious bone. The septa of the neighbouring air-cells should be broken down and the air-cells curetted. Irrigate the cavity and pack with iodoform gauze. This is changed daily until the discharge ceases.

How is the Radical Operation for Chronic Otitis Media performed?

Make an incision as before, open into the mastoid antrum and cells, and deal with them as in Schwartz's method. Next detach the pinna and the periosteum for-

wards, until the posterior and superior walls of the bony meatus are clearly visible. Through the opening made into the antrum introduce Stacke's protector; the foot-piece passes into the aditus and guards the two important structures on its inner wall, namely, the external semicircular canal and the descending portion of the facial nerve in the Aquæductus Fallopii. Chisel away the outer wall of the aditus, *i.e.* the deep part of the posterior wall of the meatus, and the outer wall of the attic, *i.e.* the inner end of the superior wall of the meatus. By this means the antrum, air-cells, aditus, attic, and tympanum become one cavity. Remove the remains of the tympanic membrane, chorda tympani nerve, malleus and incus, preserving the stapes if possible. Make the walls of the tympanum quite smooth, and scrape the orifice of the Eustachian tube. Irrigate the cavity, and endeavour to close the Eustachian orifice by swabbing it with a little pure carbolic acid. Slit the pinna in such a manner as to form a conchal flap, and suture this over the mastoid opening. Drain through the external auditory meatus.

Describe Killian's Operation on the Frontal Sinus.

A hook-shaped incision is made, the horizontal portion passing just above the superior orbital margin, and the vertical part down the middle of the nasal process of the maxilla. The incision goes to bone. Separate the soft structures carefully and chisel, or trephine, through the inner part of the superciliary ridge. Explore the sinus with a probe in order to get an estimation of its breadth. The average is about one inch. With rongeur forceps remove all the anterior wall, preserving the orbital margin intact. Scrape out the interior of the sinus. Next remove the orbital wall and the floor of the sinus until the ethmoidal cells are reached. These are freely opened and curetted. Pass a probe through the frontal ostium down the fronto-nasal duct into the infundibulum. A rubber drainage tube is inserted into the nose and the rest of the wound closed.

N.B.—*Operations upon the Jaws, Temporo-Mandibular Joint and Antrum of Highmore are described in Part I.*

TREPHING.

Describe Reid's System of Cranio-Cerebral Topography.

Reid's base line passes through the floor of the orbit and the middle of the external auditory meatus (the meatal point). A great many trephine points can be found by dropping perpendiculars to this line. The chief ones are :—

- (a) *Anterior branch of the middle meningeal artery* is $1\frac{1}{2}$ inches behind the external angular process of the frontal bone, and $1\frac{1}{2}$ inches above the line.
- (b) *Posterior branch of the middle meningeal* is 1 inch behind the meatal point, and 1 inch above the line.
- (c) *Lateral ventricle* is $1\frac{1}{2}$ inches above the meatal point.
- (d) *Temporo-sphenoidal abscess* is opened at a point $\frac{3}{4}$ inch above the posterior margin of the external auditory meatus.
- (e) *Transverse sinus* can be entered either in its horizontal portion 1 inch behind the meatal point and $\frac{1}{4}$ -inch above Reid's line, or in its sigmoid part $\frac{3}{4}$ behind the meatal point on the line.
- (f) *Cerebellar abscess* is reached: $1\frac{1}{2}$ inches behind the meatal point, and $\frac{1}{4}$ inch below Reid's line.

Give the Steps in exposing the Middle Meningeal Artery.

(a) *Anterior Branch.*

Find the surface point of the artery as given in the last question, and around it make a horse-shoe shaped flap with the base downwards. Carry the incision to bone and reflect the flap downwards. Take a $\frac{1}{2}$ -inch trephine and insert the pin opposite the surface point of the artery. Trephine, remembering to exert pressure only in the movement of supination. Remove the disc of bone and the artery will be exposed. Sometimes the artery occupies a canal in the temporal bone; in such cases plug the canal with some Horsley's wax (beeswax

7 parts, olive oil 2 parts, and carbolic acid 1 part). After exposing the artery tie it above and below the site of hæmorrhage, encircling it with fine catgut ligatures.

(b) *Posterior Branch.*

The commencement of the posterior branch can be exposed by enlarging the trephine opening used to secure the anterior branch, a little backwards. The termination of the posterior branch is reached by trephining over the surface point previously mentioned.

(c) *Main Trunk.*

The main trunk can be found by enlarging the trephine opening used for the anterior branch, downwards to the base of the middle fossa. It can be approached directly by trephining immediately above the centre of the zygoma.

What Precautions should be taken in Exposing the Brain?

(a) Administer urotropin (gr. x t.i.d.) for a week previous to the operation so as to render the cerebro-spinal fluid antiseptic.

(b) Chloroform should be the anæsthetic of choice with a preliminary injection of morphia (gr. $\frac{1}{4}$.) and scopolamin gr. $\frac{1}{100}$ th).

(c) The room and the operating table must be kept heated in order to lessen the risk of shock.

(d) Arrest all hæmorrhage quickly and work as rapidly as possible, especially in the cerebellar region.

(e) If possible operate in two stages, with an interval of seven to ten days. In the first stage the dura mater is exposed, but not opened. No anæsthetic is necessary in the second stage as the brain is insensitive.

(f) Reflect the dura by means of a horse-shoe flap; when near the base throw the flap downwards, when near the vertex, upwards.

(g) Don't ligate the large veins of the pia-arachnoid, merely displace them. Cushing has shown that paralysis may result from their ligature.

Describe the Removal of a Cerebral Tumour.

An omega-shaped incision^c is made over the area to be exposed; the base is directed downwards. Carry the incision at once to bone. Make a $\frac{1}{4}$ -inch trephine opening at each of the four corners of the flap. Remove the discs of bone. Carefully separate the dura mater from the overlying bone. A flexible grooved director is introduced between the dura and the cranium, and the Gigli saw slipped along it. Divide the bone by joining the trephine openings, cutting it in such a manner as to bevel the surfaces. Ligate any meningeal vessels, and then cut out a flap of dura mater, making the dural flap smaller than the osteoplastic flap; this facilitates subsequent suturing. Open the pia-arachnoid cautiously, avoiding any large vessels. The tumour may be either cortical or subcortical. A subcortical tumour leads to flattening of the convolutions and obliteration of the sulci. In these cases the cerebrum must be explored with a probe. Circumscribed tumours can be shelled out; the diffuse varieties should be left alone. Any resulting hæmorrhage should be arrested by packing with a little gauze. Close the wound, allowing for drainage.

Describe a Cerebral "Decompression" Operation.

This may be undertaken for irremovable tumours, or for severe intracranial hæmorrhage. The incision is made in the temporal region; it is U-shaped, with the base at the zygoma and the summit just below the temporal crest. The further steps are:—

- (a) Turn down the superficial layers of the scalp and tie the superficial temporal artery.
- (b) Split the deep temporal fascia, temporal muscle, and pericranium by an incision running downwards and forwards.
- (c) Apply a small trephine and remove the disc of bone.
- (d) Carefully separate the dura mater from the surrounding parts.
- (e) Enlarge the trephine opening with rongeur forceps until it is, roughly, the diameter of a five-shilling piece.

- (f) Pick up the dura mater and make a crucial incision in it, avoiding, or previously tying, any branches of the middle menigeal artery.
- (g) Stitch up the pericranium, temporal muscle, and deep temporal fascia, separately.
- (h) Suture back the scalp flap, providing for drainage.

N.B.—The operation, if possible, should be performed on the right side, in order not to damage the speech centres.

What is the Treatment for Temporal Abscess ?

As these abscesses are nearly always secondary to chronic otitis media, it is necessary to open the mastoid antrum in the first place, deal with it as previously described, and then attack the abscess through the tegmen tympani. The abscess can also be reached independently by making a horseshoe incision immediately above and behind the external auditory meatus. Dissect down the flap and introduce the pin of the trephine $\frac{3}{4}$ inch above Reid's line, along the posterior border of the bony meatus. Remove the disc of bone, which ought to be 1 inch in diameter, avoiding the posterior branch of the middle meningeal. A crucial incision is made in the dura, and the abscess, if cortical, will be exposed. Open it, break down any septa, and drain. Abscesses in the cerebral substance are reached by introducing through the cortex a pair of narrow-bladed sinus forceps ; they should be directed slightly forwards and inwards. Open the blades every quarter of an inch. If the abscess is not struck, withdraw the instrument for a short distance, and work in other directions until the abscess is found. Never make more than one aperture in the cortex, nor work at a greater depth than one and a half inches. After evacuating the abscess insert a rubber drain ; bring this out through a puncture made in the base of the scalp flap.

Give the Operation for Cerebellar Abscess.

This is carried out along similar lines to the treatment

of temporal abscess, but the incision runs from the apex of the mastoid process, along the superior curved line of the occipital bone, and down to a point one inch below the external occipital protuberance. The occipital artery will require ligature, and the mastoid foramen, plugging. The pin of the trephine is applied at a point $1\frac{1}{2}$ inches behind the meatal point, and $\frac{1}{4}$ inch below Reid's line.

What are the Steps for removing a Cerebellar Tumour ?

Kocher says : " It is often impossible to decide in which lobe of the cerebellum the tumour is situated. It is only when the tumour invades the base of the brain and involves special centres and nerve-roots on one side, that one can definitely locate the side on which the tumour is situated. In exposing the cerebellum, therefore, an operator must employ a method which enables him to examine the whole posterior surface of the cerebellum. This is all the more indicated by the fact that the incision to expose both sides of the posterior fossa inflicts less injury than the exposition of one side only."

Tumours in this region may be situated in a lateral lobe, the vermis, or in the cerebello-pontine angle.

Ten to fifteen minutes before the operation inject $2\frac{1}{2}$ drachms of a $\frac{1}{2}\%$ solution of novocain and adrenalin (Kocher).

- (a) The incision runs vertically upwards along the posterior margin of the mastoid process, then immediately above the superior curved line to a corresponding point on the opposite side.
- (b) Dissect down the scalp, securing the occipital vessels.
- (c) With a periosteal elevator detach the periosteum and the insertion of the occipital muscles as far as the foramen magnum.
- (d) With a 1-inch trephine remove a disc of bone from each cerebellar fossa. Enlarge this, avoiding the transverse sinuses above, and the occipital sinuses in the middle line. Freely remove the posterior margin of the foramen magnum.

- (e) Mark out the position of the blood sinuses with fine silk, introduced through the endocranial layer of the dura.
- (f) Replace the scalp flap and wait for a few days.
- (g) Make a vertical incision through the dura on each side of the occipital sinuses. Introduce an aneurysm needle through each end of the falx cerebelli and tie the occipital sinuses.
- (h) Enlarge the dural incisions so as to make two flaps, turning these downwards.
- (i) Carefully palpate the cerebellum with gloved fingers to determine the position of the tumour. If it is in the cerebello-pontine angle, displace the cerebellum laterally using a flexible spatula.
- (j) Remove the tumour if possible.
- (k) Stop all hæmorrhage either by securing the bleeding vessels or by gauze pressure.
- (l) Stitch back the dura mater and the scalp flap. Drain.

Describe Operations upon the Hypophysis Cerebri (Pituitary Body).

An attempt may be made to scrape away the tumour with a sharp spoon, or the capsule of the hypophysis may be merely opened and the growth left *in situ*. The latter procedure acts as a "decompression" operation.

Tracheotomy is first performed and the posterior nares, or pharynx, plugged.

The upper lip is retracted and a horizontal incision made through the muco-periosteum. Displace the nose upwards and divide the septum with bone forceps from before backwards. Push the septum to one side and snip off the turbinate bones until the sphenothmoidal recess is reached. Define the sphenoidal ostium; it is situated on the anterior wall of the air sinus. Enlarge the ostium until the whole of the anterior wall of the sinus has been removed. Break through the floor of the pituitary fossa, avoiding the cavernous sinus laterally, the optic chiasma in front, and the posterior cranial fossa behind. Replace the nasal septum and the nose.

LIPS, MOUTH, AND PHARYNX.

Describe the Treatment of Hare-Lip.

The bleeding can be controlled during the operation by the assistant compressing the superior coronary (labial) arteries. Whichever operation is chosen, four main points must be attended to—(i.) the raw surfaces are made very broad; (ii.) there must be no tension; (iii.) a papilla is left on the free margin; and (iv.) the flattening of the nose must be lessened.

Case I.—When a slight cleft is present, either Nélaton's method by a Λ -shaped cut (Fig. 33) or a method which employs two concave incisions (Fig. 36).

Case II.—Where it is inadvisable to pare the edges of the cleft, John Duncan's operation can be undertaken. Introduce a narrow-bladed knife at the apex of the cleft and run it along the line of junction of skin and mucous membrane, stopping a quarter of an inch from the red margin of the lip. Transfix the lip at this point and cut so as to form a small flap of the lip on each side. Fold the mucous flaps inwards, and unite them with a row of catgut stitches, next turn the skin flaps outwards and stitch them with horsehair; lastly, fold down the two small tags at the end of the cleft and suture so as to form a papilla (Fig. 40).

Case III.—When the cleft is double, care must be taken to preserve the prolabium and the os incisivum. Separate the prolabium subperiosteally and pare its edges by a U-shaped incision. Pare the lateral edges of the cleft as far as the red margins of the lips. Freely dissect the lips off the maxillæ. By means of horsehair sutures unite the lower ends of the outer margins of the clefts to each other in the middle line. Lastly stitch the remaining raw surfaces together.

If the os incisivum projects forwards, it must be bent backwards into the normal position before paring the cleft.

Describe Langenbeck's Operation for Cleft Palate.

Two lateral incisions are made through the mucoperiosteum, a quarter-inch away from the alveolar

margin of the jaw, that is, external to the posterior palatine artery. Each incision extends from the last molar tooth to the lateral incisor, thus both the posterior and the anterior palatine arteries are avoided. With a curved periosteal elevator completely detach the flaps until the cleft edges can be approximated without tension. Hold the uvula with catch forceps and with a narrow-bladed knife pare the edges of the cleft. Separate the edges freely from their connections with the nasal septum.

The second stage of the operation is carried out a few days later. It consists in introducing sutures through the flaps in order to unite them in the middle line. Silver wire is the best for the hard palate, and horsehair for the soft palate. The sutures are interrupted ones. Remove the stitches in seven to ten days.

Describe the Removal of a Malignant Naso-pharyngeal Tumour.

As the removal of these growths is attended with profuse hæmorrhage, the external carotid on one or both sides should be clamped or tied. In addition a laryngotomy is performed. The steps of the operation are :—

- (a) Divide the upper lip mesially.
- (b) With a chisel detach the alveolar process from the maxilla.
- (c) Saw through the alveolar process and the hard palate in the middle line.
- (d) Separate the two halves and remove as much of the tumour as possible.
- (e) The two portions of the palate are sutured together, and the alveolar processes wired to the maxillæ.

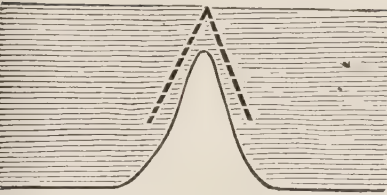
How is the Tongue excised for Epithelioma ?

When the disease has not involved any adjacent structures the tongue can be protruded beyond the mouth ; in these cases Whitehead's operation should be

OPERATION FOR HARE-LIP.

Fig. 33.

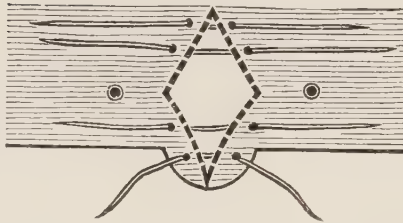
FIRST STAGE.



Incision.

Fig. 34.

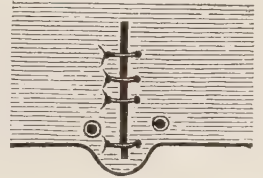
SECOND STAGE.



Sutures in Position.

Fig. 35.

THIRD STAGE.



Sutures Tightened.

OPERATION FOR HARE-LIP.

Fig. 36.

FIRST STAGE.

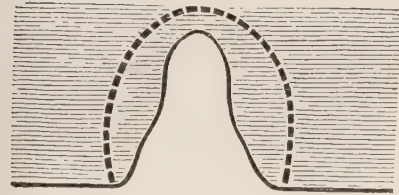
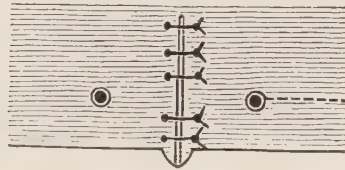


Fig. 37.

SECOND STAGE.



For Deep Suture or Pin.

Sometimes the double-flap method is used.

OPERATION FOR HARE-LIP.

Fig. 38.

FIRST STAGE.

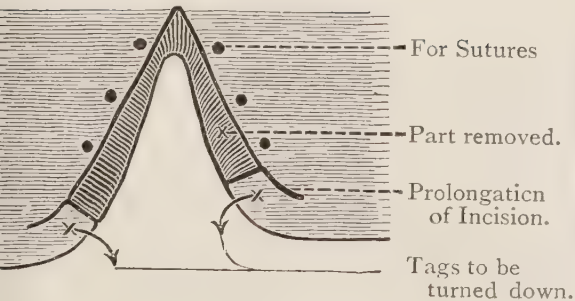
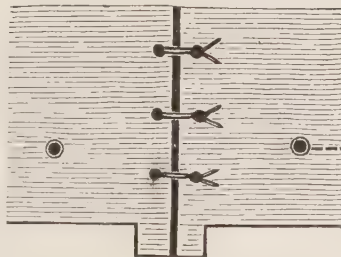


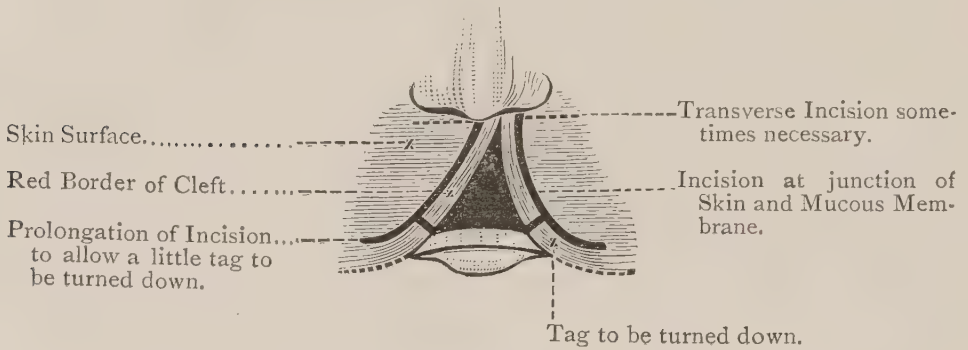
Fig. 39.

SECOND STAGE.



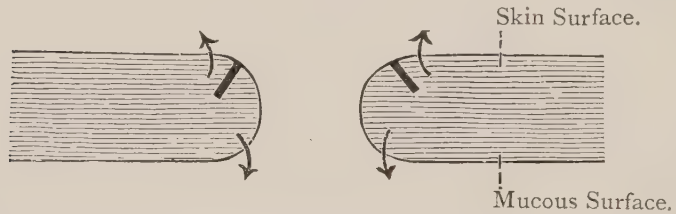
For Deep Suture or Pin.

Fig. 40.—OPERATION FOR HARE-LIP—DUNCAN'S METHOD.



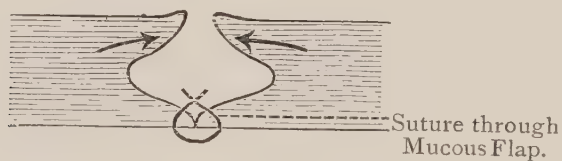
To show Cleft with Incisions used when DUNCAN'S method is adopted.

Fig. 41.—DUNCAN'S METHOD—LIP IN SECTION.



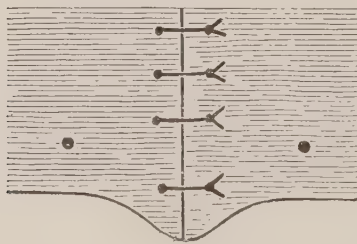
Incision at junction of Skin and Mucous Membrane. Arrows indicate how the flaps thus formed are to be turned.

Fig. 42.—DUNCAN'S METHOD—STITCHING.



Arrows show how the Skin Flaps are drawn together.

Fig. 43.—DUNCAN'S OPERATION—FINISHED.

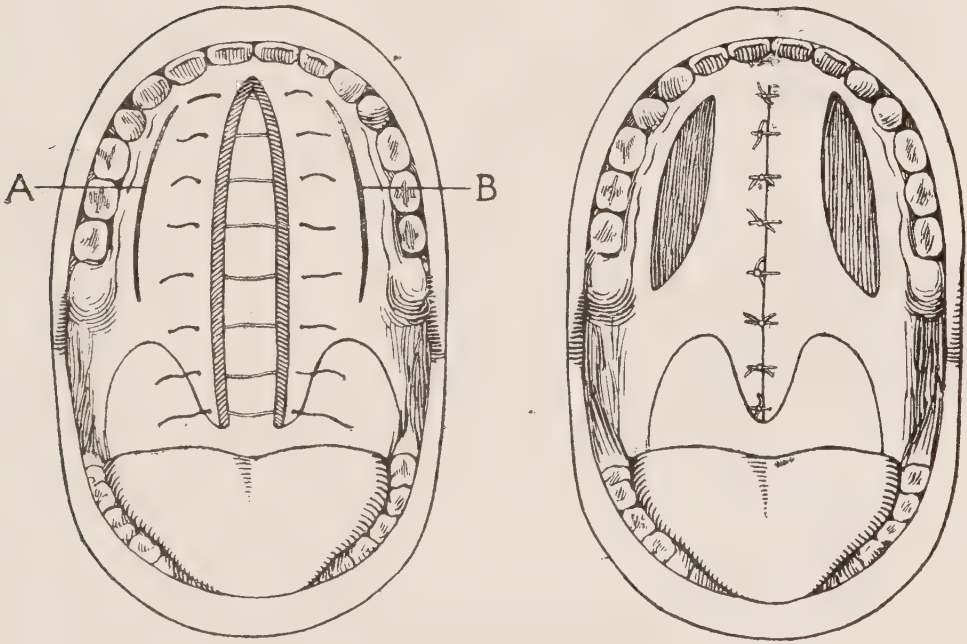


done. When the tongue is fixed, Syme's method is necessary. Either a general anæsthetic or cocaine ($\frac{1}{2}\%$ solution with a few drops of adrenalin) infiltration can be used. A preliminary laryngotomy is not essential. Ten days after excision of the tongue, the lymphatics and fascia of the anterior triangle should be removed.

Fig. 44.—OPERATION FOR CLEFT PALATE.

(1)

(2)



In (1) the lateral incisions A and B have been made, the margins of the cleft pared, and the stitches passed. In (2) the operation is completed.

Describe Whitehead's Operation.

Pass a strand of silkworm gut through each half of the apex of the tongue and draw the organ well forwards. Snip through the frenum linguæ and divide the reflection of the mucous membrane from the tongue to the mandible. Secure the ranine vessels, and sever the lingual and hypoglossal nerves. The ranine artery will be found issuing from beneath the hyoglossus; the ranine vein passes superficially to this muscle. Divide the hyoglossus, styloglossus, and palatoglossus (anterior pillar

of the fauces). Split the tongue in the mesial plane as far as the foramen cæcum, and lastly divide the genio-glossus. The dorsalis linguæ will require ligature; it is found beneath the posterior edge of the hyoglossus. Suture the mucous membrane over the raw surface of the tongue with chromic gut.

Give the Steps of Syme's Operation.

- (a) Introduce a strand of silkworm gut through the apex of the tongue.
- (b) Split the lower lip mesially and prolong the incision down to the hyoid bone.
- (c) Drill two holes through the jaw on each side.
- (d) Divide the mandible in the middle line with a Gigli saw.
- (e) Dissect down in the interval between the jaw and the hyoid, removing the submental lymphatic glands.
- (f) Detach the anterior bellies of the digastric, the mylohyoids, the geniohyoids and the genioglossi from the mandible.
- (g) Divide the mucous membrane on each side.
- (h) Put the tongue on the stretch, secure the vessels, and cut the nerves as in Whitehead's operation.
- (i) Divide the hyoglossi, styloglossi and palatoglossi.
- (j) Divide the tongue well beyond the growth.
- (k) Suture the soft parts together as carefully as possible, and wire the two halves of the jaw.
- (l) Stitch up the incision, leaving a small opening for drainage just above the hyoid bone.
- (m) Introduce a piece of silkworm gut through the stump of the tongue to prevent it falling back and obstructing the glottis.

Describe the After-treatment.

The patient should be propped up in bed after the operation to lessen the risk of septic pneumonia supervening. Careful and constant attention must be paid to the buccal toilet. Feeding by the rectum may be carried out for a couple of days.

THE NECK.

How would you treat a Retro-pharyngeal Abscess?

A three-inch incision is made along the posterior border of the sterno-mastoid, the centre of the incision being opposite the swelling. Divide the superficial structures, avoiding, or tying, the external jugular vein. Displace the sterno-mastoid forwards, and pass a director behind the carotid sheath until the abscess is reached. Introduce a pair of sinus forceps along the director and open the blades. When all the pus has been evacuated, fill up the cavity with 10% iodoform emulsion. Suture the soft parts, thus closing the wound.

Describe Sub-hyoid Pharyngotomy.

This operation enables the surgeon to deal with tumours growing in the region of the back of the tongue, epiglottis and glottis. Carry a horizontal incision along the lower margin of the hyoid bone from the apex of the great cornu on one side to a corresponding point on the opposite side. The remaining steps are:—

- (a) Divide the superficial structures, ligating the anterior jugular veins.
- (b) Cut the sterno-hyoid, omo-hyoid and thyreo-hyoid.
- (c) Tie on each side the infra-hyoid arteries; they are branches of the superior thyreoid.
- (d) Divide the central portion of the thyreo-hyoid membrane (ligament); the lateral parts of the membrane must be avoided or the internal laryngeal nerves will be injured.
- (e) Cut the mucous membrane on each side of the epiglottis, and draw the latter structure downwards. The pharynx has now been entered and the tumour can be removed with a thermo-cautery.

How is Thyrotomy performed?

This operation is undertaken for papilloma and early intrinsic laryngeal cancer. Tracheotomy should be

done first. Make a vertical incision in the middle line from the lower border of the hyoid to the upper border of the cricoid. Separate the sterno-hyoids, and the sterno-thyreoids. Divide the thyreoid cartilage in the mesial plane from below upwards. The incision passes through the anterior commissure of the true vocal cords.

Papillomata are snipped away with scissors, while an intrinsic cancer is extirpated along with the adjacent portion of the larynx (partial laryngectomy). After removing a benign growth the lateral halves of the thyreoid are sutured with chromic catgut.

Describe Laryngotomy.

Laryngotomy may be performed as an emergency operation in asphyxia, or as a preliminary to operations upon the mouth, jaws, and pharynx. The incision is vertically placed in the middle line from the upper edge of the thyreoid to the lower edge of the cricoid. Separate the sterno-thyreoid muscles, and open the larynx by incising the crico-thyreoid membrane. Avoid the crico-thyreoid branches of the superior thyreoid arteries, and the crico-thyreoid muscles (the muscles which tighten the vocal cords). Introduce a laryngotomy tube.

Give the Steps of Complete Laryngectomy.

This operation is performed for extrinsic cancer of the larynx. The lymphatic glands of the anterior triangles should be removed at a subsequent period. The following are the steps :—

- (a) Make a T-shaped incision, the vertical portion extending from the lower border of the hyoid to the suprasternal notch, and the transverse part connecting the anterior borders of the sterno-mastoid muscles.
- (b) Separate the cutaneo-fascial flaps, tying the anterior jugular veins.
- (c) Divide the sterno-hyoids, omo-hyoids, sterno-thyreoids [and thyreo-hyoids, securing the infra-hyoid arteries.

- (d) Pass a double ligature round the isthmus of the thyroid, and divide it. Separate the lateral lobes from the larynx by blunt dissection.
- (e) Cut through the crico-tracheal membrane, and stitch the trachea to the lower angle of the wound.
- (f) Hook the larynx forwards and separate off the pharyngeal mucosa, the inferior constrictors, and the palato-pharyngeal muscles. Tie the inferior laryngeal arteries, and cut the recurrent laryngeal nerves.
- (g) Pass the knife through the thyreo-hyoid membrane, and the superior cornua of the thyroid cartilage, from behind forwards. Secure the superior laryngeal arteries, and divide the internal laryngeal nerves.
- (h) Pack the wound with gauze. When healing commences, the anterior wall of the pharynx is restored by suturing the lateral parts together.
- (i) For the first week after the operation, feed the patient per rectum, and by means of an œsophageal tube.

What are the Steps of High Tracheotomy ?

A roller pillow is placed beneath the neck, and the head is kept steady by an assistant.

- (a) Make a short horizontal incision just below the cricoid cartilage.
- (b) Divide the superficial structures, ligating any transverse branches of the anterior jugular veins, and separate the sterno-hyoid muscles.
- (c) Incise the pretracheal layer of the cervical fascia by cutting on the cricoid, and displace the thyroid isthmus downwards. It may be necessary to divide the isthmus, or even the cricoid cartilage.
- (d) Steady the larynx and open the trachea *from below upwards*. Introduce a tracheal dilator through the slit, then fix in the outer tube, securing it with tapes.

- (e) Lastly slip in the inner tube, which must not be fastened in any way, and stitch up the skin wound on each side of the tube.

Give the Indications for Low Tracheotomy.

- (i) As a preliminary to pharyngotomy or complete laryngectomy.
- (ii) In inoperable cases of malignant goitre where marked tracheal pressure exists.
- (iii) For the removal of impacted foreign bodies in the trachea or bronchi.

What are the Chief Dangers of Low Tracheotomy?

- (a) The presence of the thymus gland in children.
- (b) Infection may spread to the superior mediastinum.
- (c) A thyroidea ima artery may be encountered.
- (d) The large innominate veins may bulge into the supra-sternal space.
- (e) The innominate artery may project into the neck.
- (f) The trachea is deeper, narrow, and more mobile than in its upper part.
- (g) In the lower part of the neck there is very little room between the two carotid sheaths.

Describe the Operation of Low Tracheotomy.

The head is placed in a similar position to that employed in high tracheotomy, and a vertical incision is made in the middle line from the cricoid cartilage to the suprasternal notch. Subsequently :—

- (a) Divide the superficial structures ligating the transverse branch joining the anterior jugular veins.
- (b) Separate the sterno-hyoid muscles (the fibres are directed *upwards and inwards*.)
- (c) Separate the sterno-thyroid muscles (the fibres pass *upwards and outwards*.)
- (d) Incise the pretracheal layer of cervical fascia, and tie the numerous inferior thyroid veins.

- (e) Displace upwards, or divide between ligatures, the isthmus of the thyroid body.
- (f) Steady the trachea and slit it from below upwards.
- (g) Introduce the tracheotomy tube as described in the high operation.

How is Lateral Œsophagotomy performed ?

This operation may be undertaken for (i) the removal of impacted foreign bodies ; (ii) the division of a dense fibrous stricture ; and (iii) as a means of feeding a patient suffering from cancer in this region. The steps are :—

- (a) An incision is carried along the anterior border of the left sterno-mastoid from the upper border of the thyroid cartilage to a finger's breadth above the sterno-clavicular joint.
- (b) Divide the superficial structures, and tie the anterior jugular vein.
- (c) Retract the sterno-mastoid backwards, and displace the sterno-hyoid and the sterno-thyroid inwards.
- (d) Cut the omo-hyoid, and draw the lateral lobe of the thyroid body inwards.
- (e) Retract the cartoid sheath and its contents outwards.
- (f) Divide the inferior thyroid artery between ligatures.
- (g) Pass a bougie down the œsophagus.
- (h) Incise the œsophagus on its postero-external aspect in order to avoid the recurrent laryngeal nerve which lies in a sulcus between the œsophagus and the trachea.
- (i) After dealing with the condition found, suture the œsophagus with three layers of superimposed stitches.
- (j) Drain the wound.

Describe Cervical Œsophagectomy.

Œsophagectomy is undertaken for epithelioma involving the cervical portion of the tube. Tracheotomy and gastrostomy should be performed first (Kocher).

The lateral lobe of the thyroid gland, the recurrent laryngeal nerve, and a portion of the trachea, have frequently to be sacrificed.

The "collar" incision used for goitres (see post) gives the best access. If the thyroid gland is affected, the thyroid vessels on that side should be secured, and the isthmus crushed and divided. The œsophagus is freed near the manubrium and at its origin. At the latter part the inferior constrictor muscle is divided. Separate the cervical portion of the tube from the vertebral column, and if possible, from the trachea. Open the lower part of the œsophagus below the growth, introduce a stiff stomach tube, ligature the œsophagus round the tube, then cut across above this point. Apply a circular ligature above the tumour, and divide the lower part of the pharynx. Plug the wound, leaving the tube *in situ*.

How is an Œsophageal Diverticulum removed?

Before anæsthetising the patient empty the diverticulum. The incision and preliminary steps are identical with those used in lateral œsophagotomy. After displacing the sterno-mastoid backwards, and the sterno-hyoid and thyroid inwards, the omo-hyoid is divided. Elevate the inferior pole of the thyroid body and secure the inferior thyroid vessels. Stiffen the œsophagus by introducing a bougie through the mouth, and separate the diverticulum by blunt dissection. Open it, excise it, and suture the stump by three rows of superimposed stitches. The wound should be drained.

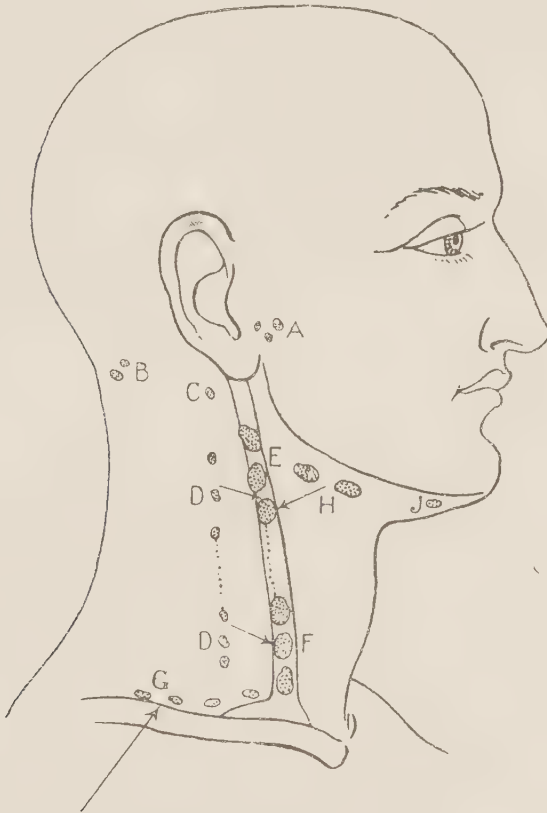
Describe the Arrangement of the Lymphatic Glands in the Neck.

The superficial cervical chain (the glandulæ concatenatæ) is closely related to the external jugular vein, and accordingly is found more or less along the posterior edge of the sterno-mastoid. The glands are superficial to the cervical fascia; their efferent trunks terminate in the lower group of the deep cervical glands.

The deep cervical chain is found beneath the superficial layer of cervical fascia, along the anterior border

of the sterno-mastoid, and accompanying the internal jugular vein. It is arranged in two groups, superior and inferior, each of which is subdivided into medial and lateral. The former covers the internal jugular, and when enlarged projects into the anterior triangle; the lateral groups lie postero-external to the vein, resting

FIG. 45.—CERVICAL GLANDS.



A. Parotid.
B. Occipital.
C. Mastoid.

D. D. Superficial Cervical.
E. Upper Deep Cervical.
F. Lower Deep Cervical.

G. Supra-clavicular.
H. Submaxillary.
J. Submental.

upon the splenius and levator scapulæ muscles, and are in close relation to the spinal accessory nerve. The superior set extends from the basis cranii to the bifurcation of the common carotid, *i.e.* to the upper margin of the thyroid cartilage; the inferior set from this point to the sterno-clavicular joint.

The *occipital* glands lie upon the trapezius at the base of the occiput; further forwards upon the sterno-mastoid are the *mastoid* glands. In the anterior tri-

angle note the *submental* group between the anterior bellies of the digastric, and the *submaxillary* group over the submaxillary gland.

What are the Steps in Butlin's Operation for removing Malignant Glands in the Neck?

The shoulders should be raised and the head drawn over to the opposite side.

- (a) The incision extends down the anterior border of the sterno-mastoid, from the apex of the mastoid process to the sterno-clavicular articulation. A second incision is made from a point opposite the upper border of the thyreoid cartilage to the symphysis menti.
- (b) Dissect up two flaps of skin and platysma, preserving, if possible, the external jugular vein, but tying the anterior jugular.
- (c) Divide the cervical fascia along the anterior border of the sterno-mastoid, and retract the muscle backwards.
- (d) Displace the depressors of the hyoid bone inwards, stripping them of their investing fascia first. Avoid injury to the descendens hypoglossi nerve.
- (e) Commencing from below, dissect up the fascia and the subjacent lymphatic glands, even separating off the carotid sheath.
- (f) If the fascia is firmly adherent to the internal jugular, ligate the vein and remove it from below upwards.
- (g) Carefully strip off the fascia around the submaxillary and the lower part of the parotid glands, and at the same time remove the lower part of the parotid itself.
- (h) Remove the following glands—(a) submental; (b) the one between the angle of the mandible and the internal pterygoid; and (c) a small node between the genio-hyoid muscles. Avoid the spinal accessory, hypoglossal, and vagus nerves; if one be accidentally severed, carefully suture it again.

- (i) Stitch back the flaps, providing for drainage.
- (j) If necessary, the opposite anterior triangle can be cleared after an interval of ten days.

Describe the removal of Tuberculous Glands from the Neck.

If the involved glands are confined to the anterior triangle, an oblique incision on the line of one of the natural folds should be made. When the glands have to be removed from both the anterior and the posterior triangles, the Z-shaped incision is used. The upper horizontal portion of the incision skirts the lower border of the mandible, the oblique part lies over the sternomastoid muscle, while the lower horizontal line is situated immediately above the clavicle. The glands are dissected free by means of Mayo's conical scissors. The chief structures to avoid are :—

ANTERIOR TRIANGLE—

- (a) The lingual and common facial veins.
- (b) The hypoglossal, vagus, spinal accessory, and descendens hypoglossi nerves.
- (c) The internal jugular vein.
- (d) The thoracic duct on the left side.

POSTERIOR TRIANGLE—

- (a) The external jugular vein.
- (b) The spinal accessory, phrenic, and the motor branches from the cervical plexus to the trapezius and scaleni.

How would you remove a Cervical Rib ?

Make a horizontal incision three inches long immediately above the centre of the clavicle. Divide the superficial structures including the descending branches of the cervical plexus. The further steps are :—

- (a) Identify the posterior border of the sternomastoid and secure the external jugular vein.
- (b) Divide the omo-hyoid, and tie the transversalis colli vessels.
- (c) Note the position of the subclavian vein, and protect it from injury.
- (d) Define the posterior margin of the scalenus

- anterior, also the lower cervical and first dorsal nerves issuing from beneath it.
- (e) Palpate the cervical rib and note its relation to important neighbouring structures, namely, the third part of the subclavian artery, the cervical pleura, the lower trunk of the brachial plexus, and the phrenic nerve.
 - (f) Carefully dislodge these structures and excise the rib subperiosteally. Lastly, the periosteum must be cautiously removed.

Describe Kennedy's Operation for Erb-Duchenne Paralysis.

An oblique incision is carried from the posterior margin of the sterno-mastoid, at the junction of its middle and lower thirds, to the junction of the middle and outer thirds of the clavicle. Divide the superficial structures, securing the external jugular vein. Then—

- (a) Define the posterior border of the sterno-mastoid, and cut the posterior belly of the omo-hyoid.
- (b) Divide the deep cervical fascia, and expose the scalenus anterior with the upper part of the brachial plexus.
- (c) Identify the fifth and sixth cervicals uniting to form the upper trunk of the plexus; trace the upper trunk as far as its three branches, *i.e.* the anterior division, the posterior division, and the suprascapular.
- (d) Raise the fifth and sixth cervicals on an aneurysm needle; divide them and examine the cut *central* ends to see if they are healthy. If not, remove a little more centrally until a sound section is obtained.
- (e) In a similar fashion divide the suprascapular, the anterior, and the posterior divisions. Examine their *distal* ends, and cut distally until healthy nerve is reached.
- (f) Dissect away the intervening unhealthy nerve.
- (g) Suture the fifth and sixth cervicals into the three peripheral branches. The suture line may be protected with Cargile membrane.

- (h) After closing the wound, elevate the corresponding shoulder and depress the head to that side. Fix in plaster for six weeks. Massage and electricity are required later.

How is the Thymus Gland removed?

Kocher's "collar" incision (see post) is employed, but at a slightly lower level than that made for the removal of a goitre. After separating the sterno-hyoids and sterno-thyroids, the pretracheal layer of cervical fascia is cut and the inferior thyroid veins ligated. The capsule of the gland covers the trachea and projects above the suprasternal notch. Apply gentle traction to the capsule and incise it. By blunt dissection dislodge the gland out of its capsule. Close the wound.

Describe the Operation for Malignant Disease of the Parotid.

Two incisions are made, one passing along the anterior border of the sterno-mastoid from the apex of the mastoid process to the upper edge of the thyroid cartilage; this incision is joined by a horizontal one carried over the most prominent part of the swelling.

On the anterior aspect of the gland secure the transverse facial vessels and divide Stensen's duct. On the lower border the external jugular vein is tied. Divide the temporal fascia and secure the superficial temporal vessels issuing from the upper border. Dissect up the gland from the posterior belly of the digastric and stylohyoid until the external carotid is defined; tie it, but avoid injury to the hypoglossal nerve. By blunt dissection separate the gland from the external auditory meatus, masseter muscle, and temporo-mandibular joint. The facial nerve is removed along with the gland.

THYROID BODY.

Give the main points in the Surgical Anatomy of the Thyroid Body.

In addition to its proper or true capsule, the thyroid is enveloped by a sheath derived from the pretracheal layer of cervical fascia. This is firmly connected by

fibrous strands to the trachea and œsophagus. As usually described, the thyreoid consists of two lateral lobes united across the middle line of the neck by a transverse commissure, the isthmus; this covers the second, third and fourth rings of the trachea. In many subjects a pyramidal lobe is also present.

The thyreoid body has in front the sterno-hyoid, omohyoid, sterno-thyreoid, and a portion of the sterno-mastoid muscles. Behind are the trachea, the lower part of the larynx, the œsophagus (on the left), the pharynx, the carotid sheath with its contents, inferior thyreoid arteries and the recurrent laryngeal nerves. The gland is exceedingly vascular, the arteries being the superior and inferior thyroids. The inferior thyreoid veins pass down anterior to the trachea and open into the left innominate; the remaining thyreoid veins terminate in the internal jugulars. The parathyroids are usually four in number, two superior and two inferior. They are embedded in the fascial sheath on the posterior aspect of the gland. During goitre operations great care must be taken not to injure the parathyroids, or tetany will result.

What are the Indications for Operative Treatment in Goitres?

“All goitres should be operated upon when they are nodular, cystic, or becoming adherent, especially in the case of adults; when they extend into the thoracic inlet, or compress the trachea, and, lastly, when there is the least suspicion of malignancy, *i.e.* from the character of their growth, their hardness, irregularity, and fixation.” Kocher.

What conditions does Kocher lay down for Goitre Operations?

- (a) Strict aseptic, not antiseptic precautions.
- (b) Substitute novocain and adrenalin for a general anæsthetic. With nervous patients, if the heart and lungs are sound, ether can be used.
- (c) A large incision should be made.
- (d) Careful ligature of all vessels connected with the goitre.

- (e) Preserve the sterno-laryngeal muscles together with their nerve supply.

Describe Kocher's Operation for Movable Goitre .

The patient's head should be raised and the neck extended. The "collar" incision is made. This connects the posterior borders of the sterno-mastoid muscles, and is slightly convex downwards, the lowest point reaching just below the cricoid cartilage. The subsequent steps are :—

- (a) Divide the superficial structures, ligating the anterior jugular and the "oblique veins."
- (b) Recognise the depressors of the hyoid, namely, the omo-hyoid, sterno-hyoid and sterno-thyreoid on each side.
- (c) Retract the sterno-mastoids backwards and define the anatomical middle line between the sterno-hyoids. Sever these muscles high up in order to keep their nerve-supply intact.
- (d) Deal in a similar manner with the sterno-thyreoid muscles, thus exposing the sheath of the thyroid (Kocher's capsule).
- (e) Open the sheath, and carefully dissect the goitre from it. The fibrous bands connecting the sheath to the goitre contain the "accessory veins;" they must be doubly clamped before division.
- (f) The goitre is separated until the upper pole is reached; the superior thyroid vessels are secured.
- (g) Dislocate the goitre towards the middle line and ligate the inferior thyroid artery; *carefully avoid the recurrent laryngeal nerve.*
- (h) Separate the isthmus from the trachea; tie the "communicating" veins on the upper and lower borders. Secure the inferior thyroid veins issuing from the lower part of the isthmus.
- (i) Crush the isthmus, tie it, and divide it between ligatures.
- (j) Free the lateral lobe from the larynx and

trachea, leaving a thin slice of glandular tissue to protect the recurrent laryngeal nerve.
Avoid injury to the parathyreoid glands.

- (k) Secure any bleeding vessels, suture the cut sterno-hyoids and sterno-thyreoids, and close the wound. Drain by means of a small glass tube. Remove it in 48 hours.

What is the After-Treatment ?

Give copious draughts of hot water, and administer ten grain doses of aspirin to relieve the pain in the muscles of the neck. If mucus begins to collect in the respiratory passages, push atropin and give oxygen when necessary. Irritation of the parathyreoids may lead to slight symptoms of tetany ; calcium lactate will then be called for.

Give the Operative Treatment for Exophthalmic Goitre.

Operative treatment is most effectual when carried out in the early stages of the disease. Ligature of the superior thyreoids vessels on one side may be first tried ; if this is ineffectual, tie the opposite superior thyreoid vessels. Often this treatment will cure the patient. Even if a cure is not effected, the patient is greatly benefited and can withstand the more severe procedure of removal of one half of the gland at a later date. Crile has suggested that ligature of the vessels acts by interfering with the secretory nerves accompanying them.

Describe Kocher's Angular Incision for the Thyreoid.

This incision is preferred in inflamed goitres, very large goitres, and in malignant disease of the gland. It commences over the sterno-mastoid on the affected side, opposite the upper border of the thyreoid cartilage, passes inwards to the middle line obliquely, and then downwards as far as the supra-sternal notch. Dissect down the cutaneo-fascial flap, securing the anterior jugular and the oblique veins. Retract the sterno-mastoid backwards, and divide the sterno-hyoid and sterno-thyreoid muscles as high up as possible. The goitre is then dealt with as described before.

OPERATIVE SURGERY.

PART III.

THE ABDOMEN AND PELVIS.

THE KIDNEY.

Give the main Points in the Surgical Anatomy of the Kidneys.

The kidneys occupy the paravertebral recesses behind the peritoneum, and lie opposite the bodies of the last dorsal and the first three lumbar vertebræ; the right kidney usually being half an inch lower than the left one. On an average the inferior poles of the kidneys are found from one, to one and a half inches, above the highest part of the crest of the ilium. The kidneys are placed obliquely, the long axis being directed downwards, outwards, and slightly forwards.

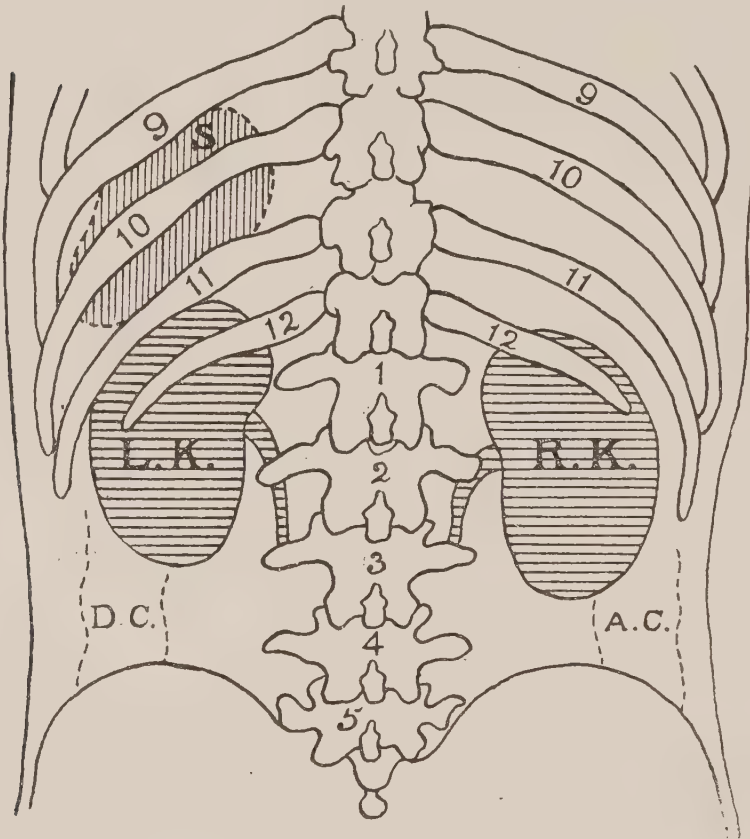
The hilum is found on the internal border; it is the mouth of a deep recess, the renal sinus; lodged within the sinus are the renal vessels and the ureter; from before backwards, the arrangement is vein, artery, and ureter.

The anterior relations of the right kidney are—liver, descending part of the duodenum, hepatic flexure of the colon, small intestine, and right adrenal. In front of the left kidney are—stomach, pancreas, spleen, jejunum, descending colon, and right adrenal.

Behind each organ are—psoas, quadratus lumborum, diaphragm, and transversalis muscles; the last dorsal, ilio-

hypogastric, and ilio-inguinal nerves; the subcostal artery and the pleural cavity for a short distance.

Fig. 46.—THE KIDNEYS, SPLEEN, AND COLON FROM BEHIND.



L.K. Left Kidney,
R.K. Right Kidney.

D.C. Descending Colon.
A.C. Ascending Colon.

S. Spleen.

What are the Fascial Investments of the Kidney?

- (a) A true capsule covering the kidney and lining the renal sinus.
- (b) An adipose capsule also dipping into the sinus.
- (c) The perirenal fascia developed from the sub-peritoneal fat. This fascia splits at the outer border of the organ into two lamellæ, which embrace the adipose capsule and the kidney. Vertically the lamellæ become continuous over the adrenal gland.

Mention the Chief Operations performed on the Kidney.

- (i) **NEPHROTOMY**—undertaken for the purpose examining the interior of the kidney, or as a preliminary to drainage, or for the removal of a calculus.
- (ii) **NEPHRO-LITHOTOMY**—removing a calculus from the kidney.
- (iii) **NEPHROSTOMY**—drainage of the kidney.
- (iv) **NEPHROPEXY**—fixing a movable kidney.
- (v) **NEPHRECTOMY**—excision of a kidney.

What are the steps in Lumbar Nephrotomy?

The patient lies on his sound side, an air-cushion or sand-bag being placed between the lower costal margin and the iliac crest. The incision commences in the angle between the erector spinæ (sacro-spinalis), and the last rib, and extends downwards and forwards in the direction of the anterior superior iliac spine for about five inches. The subsequent steps are :—

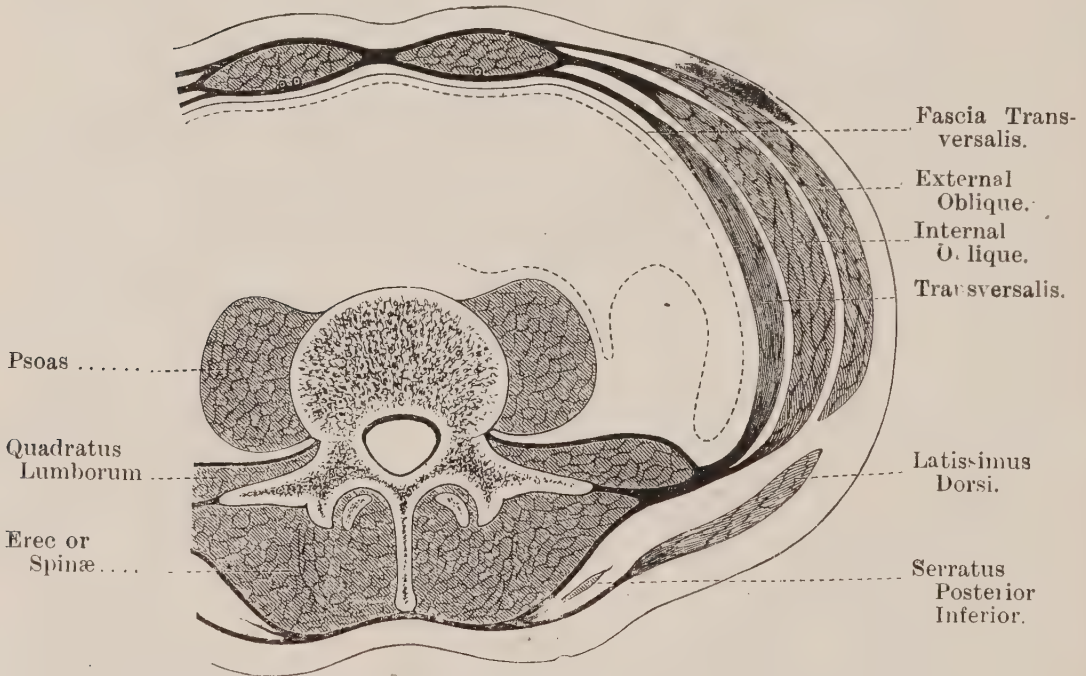
- (a) Divide the skin and fascia, exposing the external oblique and the latissimus dorsi, and beneath the latter muscle, the serratus posterior inferior.
- (b) Incise the internal oblique.
- (c) Divide the transversalis abdominis and the lumbar fascia.
- (d) Retract the quadratus lumborum inwards.
- (e) Displace the last dorsal nerve and the subcostal artery upwards, and cut the transversalis fascia.
- (f) Open the perirenal fascia, and incise the adipose capsule until the kidney, surrounded by its true capsule, is exposed.

N.B.—Sometimes a distended colon may be endangered during the operation. In such cases displace it gently forwards, and protect it by a pad of gauze.

Describe Nephro-lithotomy.

The kidney is exposed as before, and made to present through the wound. A clamp is placed upon the vessels at the hilum and the organ carefully packed off with gauze. By palpation of the renal substance and of the pelvis an endeavour is made to locate the stone. If it is in the pelvis, this may be opened (*pyelotomy*), and the calculus removed. When the stone is impacted in one of the calyces, the

Fig. 47.—PARTS DIVIDED IN EXPOSURE OF THE KIDNEY.
(From CUNNINGHAM'S *Anatomy*.)



The dotted line represents the peritoneum. The fascia transversalis is only figured in front. The kidney lies in the angle between the psoas and quadratus muscles.

kidney should be incised on its posterior surface about half an inch behind the convex margin, *i.e.* through the “ex-sanguine” line. The pelvis and calyces are systematically explored with the finger until the stone is discovered. Remove it, enlarging the renal incision as may be necessary, and pass a probe down the ureter. Suture the wound in the kidney by deep and superficial stitches, afterwards

draining the wound. If phosphatic calculi are found, the kidney will be infected; in these cases, fix a drainage tube into the renal pelvis (*nephrostomy*).

How is Nephropexy performed?

The usual lumbar incision is made, the kidney delivered through the wound and packed around with gauze. The true capsule is incised along the convex margin of the organ, and by blunt dissection is peeled off the interior and posterior surfaces. Pass stitches through the separated capsule, and replace the kidney in its proper position. Secure the stitches by introducing them into the neighbouring aponeurotic structures and then tying. Now proceed to form a shelf beneath the lower pole of the kidney. This is done by stitching the anterior and posterior lamellæ of the perirenal fascia together, anchoring them by stitches to the peritoneum along the outer margin of the colon, and to the aponeuroses of the abdominal wall. Lastly, in order to encourage adhesions beneath the kidney, the infra-renal space is packed with gauze; this is left *in situ* for a couple of weeks.

Give the Indications of Nephrectomy.

Treves and Hutchison classify these as follows:—

A.—*When life is threatened by the presence of the diseased kidneys.*

- (1) Primary malignant disease of the kidney including the rare papilloma of the renal pelvis secondary to stone.
- (2) Disorganisation of the kidney by injury, when suture is impossible, or hæmorrhage uncontrollable.
- (3) Early tuberculosis confined to one kidney and ureter.
- (4) Disorganisation of one kidney by tuberculosis, if it is certain that the other organ is able to carry on the total urinary excretion.
- (5) Rare cases of aneurysm of the renal artery.

B.—*When practically the whole of the excretory tissue of one kidney has been destroyed by disease which all other methods have failed to relieve.*

- (1) Renal calculus leading to complete atrophy, or hydronephrosis.
- (2) Hydronephrosis or pyonephrosis, when the wall is formed by a mere shell of fibrous tissue.
- (3) Incurable renal or ureteric fistula, if the other kidney is healthy.
- (4) Congenital cystic kidney, giving rise to persistent unilateral hæmaturia which is dangerous to life, or having become the seat of multiple abscesses.

What Points must be determined before Nephrectomy is carried out?

- (a) The presence of a second kidney.
- (b) If the second kidney is healthy or not.
- (c) The capability of the second kidney to perform alone the renal functions of the body.

Describe the Operation of Nephrectomy.

In the case of large or malignant tumours, the kidney is generally removed transperitoneally, otherwise the lumbar route is preferred. In malignant tumours the renal capsule must be dissected away with the kidney as it belongs to the same lymphatic territory.

A.—LUMBAR NEPHRECTOMY. The usual kidney incision is made and the various structures divided as before. The capsule is split and the organ carefully separated (in malignant disease this step is omitted), until the pedicle can be reached. The renal vessels are secured and ligated, the artery before the vein. Dissect the ureter from the vessels, tie it, and divide it with the cautery. Now carefully examine the pedicle for any bleeding points, as sometimes abnormal arteries are present. In certain cases it is impossible to ligate the artery and the vein separately.

Close the parietal wound by sutures and introduce a

drainage tube down to the renal bed. Unless suppuration occurs, the tube may be removed on the second or third day.

B.—ABDOMINAL NEPHRECTOMY. A vertical incision about four inches long is made either in the middle line or through the rectus muscle; the incision commences immediately below the costal margin. After dividing the several layers of the abdominal wall, the small intestines are encountered; they are displaced gently and the colon identified.

A vertical incision is made through the peritoneum along the outer border of the colon, and the latter pushed towards the mesial plane. By blunt dissection the kidney is freed from its adipose capsule and the pedicle exposed. The upper pole of the kidney is usually the most difficult part to separate, so it is better to leave it until the last. *Avoid injury to the suprarenal body.*

Next isolate the renal artery, renal vein, and ureter; on the right side remember the close proximity of the inferior vena cava. Secure the vessels and divide the ureter. After removing the kidney, suture the divided peritoneum. A drainage tube is brought out at the loin along the outer margin of the quadratus lumborum.

THE URETER.

Describe the Surgical Anatomy of the Male Ureter.

From the hilum of the kidney the ureter descends retro-peritoneally upon the psoas, crosses the bifurcation of the common iliac artery, and enters the pelvic cavity. Here it passes anterior to the internal iliac artery, the obturator vessels and nerve, and the obliterated hypogastric artery. Lastly, curving inwards, it runs behind the vas deferens, and descends along the posterior wall of the bladder to enter that viscus about one and a half inches above the base of the prostate. The ureters pierce the vesical wall very obliquely, and open by two small slit-like orifices. Crossing the ureters in the abdomen are the spermatic vessels. The ureter is narrowed (i) at its junction with the renal pelvis; (ii) at the point of crossing the common iliac artery; and (iii) at its vesical orifice.

Describe Uretero-lithotomy.

A calculus may become impacted either in the (a) abdominal, the (b) abdomino-pelvic, or (c) the intra-vesical portions of the ureter.

Abdominal.—Prolong the usual lumbar incision for the kidney, a little downwards and forwards. Expose the kidney as previously described and isolate the ureter. Identify the position of the stone, incise the ureter over it and remove it. Pass a probe down the ureter into the bladder in order to demonstrate the absence of an additional calculus. Suture the cut in the ureter with catgut, taking care that the stitches do not penetrate the mucosa. Drain the external wound.

Abdomino-pelvic.—With the patient in the Trendelenburg position, make a vertical incision either in the middle line or through the rectus muscle, above the pubes. Open the peritoneum and pack off the intestines. Feel for the bifurcation of the common iliac artery; incise the parietal peritoneum there and identify the ureter. Open it and remove the calculus. Suture as before.

Intra-vesical.—Open the bladder suprapubically, palpate the stone, cut through the overlying mucous membrane, and remove the stone with a scoop. Suture the bladder incision.

Describe Lumbar-Ureterostomy.

After total excision of the bladder and in inoperable cases of malignant disease of the bladder or prostate, the ureters are stitched to the skin in the lumbar region. After one ureter has been transplanted, a week or ten days should elapse before the second ureter is dealt with.

Make the usual lumbar incision for exposing the kidney and upper part of the ureter. Identify the ureter, divide it about three or four inches below the kidney. Split its opening transversely and stitch it to the skin at the outer border of the erector spinæ. Pass a ligature around the distal end of the ureter and cauterise its mucous membrane.

THE BLADDER.

What are the Chief Relations of the Bladder?

Superior.—Pelvic colon and a few coils of small intestine.

Posterior.—Vesiculæ seminales.

Vasa deferentia.

Recto-vesical layer of pelvic fascia.

Infero-lateral.—Pubes and retro-pubic fat.

Fascia covering obturator internus and levator ani muscles.

Pubo-prostatic ligaments.

Laterally.—Obliterated hypogastric arteries.

Vasa deferentia.

Peritoneal Relations.—The superior surface is completely covered; the infero-lateral is non-peritoneal; the lateral has peritoneum above the obliterated hypogastric arteries; and the basal surface is non-peritoneal below the attachment of the ureters.

Give the Vascular Supply and Lymphatic Drainage.

The vascular supply is derived from the superior and inferior vesical branches of the internal iliac. The lymphatic vessels ramify in the muscular coat (neither the ureter nor the bladder have any lymphatics in their mucosa), and drain into two small groups of glands, (*a*) anterior vesical, near the apex, and along the course of the superior vesical vessels; and (*b*) lateral vesicle, near the obliterated hypogastric arteries. From both groups of glands efferents pass to the iliac and hypogastric nodes.

Mention the Indications for Suprapubic Cystotomy.

- (*a*) The removal of a vesical calculus in cases where lithotrity is contra-indicated.
- (*b*) As a preliminary to partial or complete cystectomy.
- (*c*) For the removal of villous papillomata.
- (*d*) As a preliminary to suprapubic prostatectomy.
- (*e*) For “retrograde” catheterisation.
- (*f*) In extra-peritoneal rupture of the bladder.
- (*g*) As a preliminary to suprapubic cystostomy.

Describe Suprapubic Cystotomy.

A rubber catheter is passed and the urine drawn off. Wash out the bladder with warm boracic lotion, then fill the viscus either with the same fluid or with warm saline. The quantity of fluid required is:—

In children 3-6 ounces.

In adults 8-10 ounces.

Allow the fluid to run in slowly, noting the degree of distension by a hand above the pubes. With the patient in the Trendelenburg position, an incision is made in the middle line extending to the pubes, or, where an extensive operation is contemplated, Kocher's horizontal incision in the interspinous line should be made.

STEPS.—1. Divide the skin and superficial structures ligating the branches of the common femoral vessels encountered.

2. Divide the anterior layer of the sheath of the rectus and separate the muscles in the middle line. It may be necessary to cut the muscles transversely just above the pubes.

3. Cut through the fascia transversalis, thus exposing the extra-peritoneal fat. Cautiously dissect through this and the bladder wall is exposed.

4. Introduce a couple of fixation sutures into the bladder, and make a small vertical cut between them. Thrust a finger into the viscus before all the fluid escapes.

5. Secure the edges of the mucous membrane with toothed forceps.

6. If the operation has been undertaken for vesical calculus, the stone can now be removed either with forceps or a scoop; if for papillomatous disease, the affected mucous membrane is cut away, and all hæmorrhage checked by irrigation with hot saline, or in severe cases by gauze packing.

7. When hæmorrhage has ceased, a glass drainage tube enclosing a large rubber catheter is introduced, and connected to a suction apparatus.

8. The superficial wound is stitched around the tube.

Give the Operative Treatment of Ectopia Vesicæ.

Operative treatment is best commenced during the fourth year. Peters' extraperitoneal operation will be described. After completely emptying the bowels by means of aperients and enemata, a sponge, to which is fixed a long silk thread, is pushed high up into the rectum.

STEPS.—1. Identify the ureteral orifices and introduce a small catheter into each; the catheter should be fixed by a single stitch.

2. With scissors cut out a small rosette of mucous membrane from the posterior vesical wall around each ureter.

3. By blunt dissection isolate the lower inch or inch and a half of the ureters.

4. Make a slit in each lateral wall of the rectum just above the internal sphincter and pull the corresponding catheter and ureter through. The ends of the catheters project beyond the anus, while the rosette of mucous membrane acts as a flange.

5. In a few days the catheters become loose and can be withdrawn.

At a later stage the rest of the posterior vesical wall is dissected away. No plastic operation is required to cover in the defect of the anterior abdominal wall.

In Stiles' operation for ectopia vesicæ, the left ureter is implanted into the ascending limb of the pelvic colon, and the right ureter into the descending limb.

Describe Partial Cystectomy.

With the patient in the high Trendelenburg position a median incision is made from just below the umbilicus to the pubes. After dissecting through the abdominal wall, the peritoneum is opened, and the bladder area packed off. Seize the bladder and lift it into the wound.

STEPS.—1. Open the anterior wall by a vertical incision and examine the growth.

2. Identify the ureters and pass a small catheter into each.

3. Split the peritoneum over the bladder sagittally and dissect it off the wall.

4. Remove the affected area of the bladder, carefully avoiding the ureters if healthy; if they are involved in the disease, the adjacent portions must be excised. In such cases the stump of the ureters must be dissected free and implanted afresh into the healthy bladder wall.

5. Suture up the bladder wall, the peritoneum over it, and the parietal peritoneum.

6. Close the abdomen.

Describe Median Perineal Cystotomy.

Except for the removal of a calculus impacted in the neck of the urethra, this operation is rarely undertaken nowadays. After filling the bladder as before, the patient is placed in the lithotomy position and a staff with a median groove passed. Make a median incision from the perineo-scrotal junction to a point one inch in front of the anus.

STEPS.—1. Deepen the incision by dissection until the point of the knife engages in the groove on the staff. The following structures are encountered:—(a) skin and fascia; (b) central point of perineum and anterior fibres of sphincter ani externus; (c) base of triangular ligament; (d) compressor urethræ muscle; (e) membranous urethra.

2. Keeping the knife in the groove divide the urethra.

3. Withdraw the staff and introduce the finger or lithotomy forceps.

4. After the stone has been removed pass a drainage tube into the bladder.

THE PROSTATE.

Give the Main Points in the Surgical Anatomy of the Prostate.

The gland lies between the symphysis pubis and the rectum, and is about one and a quarter inches from the

anus. Its size is one and a quarter inches vertically and one and a half inches transversely. Surrounding the organ is a fascial envelope termed the sheath. On the anterior aspect the sheath is formed by the dense tissue in which the pudendal plexus is embedded; laterally by the pelvic fascia clothing the upper surface of the levator ani, and behind by the blending of the recto-vesical layer of pelvic fascia with the fascia of Denonvillier, the latter being derived from the peritoneum, which in the foetus extends along the anterior surface of the rectum. At the prostatic apex the sheath fuses with the pelvic aspect of the triangular ligament. The upper surface of the prostate lies immediately beneath the internal sphincter and the mucous membrane of the bladder. Within the sheath is the true capsule or cortex; it is a portion of the stroma devoid of glandular tissue. It cannot be separated from the rest of the organ. The "false capsule" is a band of atrophied fibrous and glandular tissue which in senile enlargement of the prostate surrounds an area of glandular hyperplasia.

What are the Chief Relations?

Anterior.—The lower part of the symphysis pubis, pudendal plexus, retro-pubic pad of fat, space of Retzius, and the dorsal vein of the penis.

Superior.—The bladder, seminal vesicles, and the ampullæ of the vasa deferentia.

Inferior.—The parietal layer of the pelvic fascia.

Lateral.—The levator ani muscles.

Posterior.—The space of Denonvillier and the rectum.

What Structures pass through the Prostate?

Three structures traverse the prostate, namely, the urethra towards the front of the gland and the common ejaculatory ducts in the posterior portion. The area including the common ejaculatory ducts is often called the posterior lobe, the part between the ejaculatory ducts and the urethra is the middle lobe, while flanking the urethra are the lateral lobes.

Give the Bloodvessels and Lymphatic Drainage.

The vascular supply is derived mainly from the inferior vesical and middle hæmorrhoidal arteries. The venous plexus is embedded between the sheath and the cortex, and is found on the anterior and lateral aspects of the prostate. Terminating in the pudendal plexus is the dorsal vein of the penis; the plexus itself opens into the internal iliac veins.

Lymphatic vessels commence in networks around the acini of the gland, and drain into the iliac, hypogastric, and sacral nodes.

Describe Suprapubic Prostatectomy.

A metal catheter is introduced into the bladder, and the bladder washed out and refilled with saline as in suprapubic cystotomy. With the patient in the Trendelenburg position, Kocher's incision is made in the interspinous line (see *ante*).

STEPS.—1. The dissection to reach the bladder has been described under suprapubic cystotomy. The bladder is opened as in that operation and the prostate examined with the finger.

2. Scratch through the mucous membrane covering the enlargement behind the internal meatus, and seek the "plane of cleavage" between the enlargement and the false capsule.

3. Using the finger as a dissector, separate the hyperplastic mass, the gland being meanwhile thrust forwards from the rectum. According to the degree and situation of the enlargement the operation will consist in either—

- (a) "Total" enucleation with removal of the prostatic urethra.
- (b) "Total" enucleation without removal of the prostatic urethra.
- (c) Lobar enucleation, or
- (d) Nodular enucleation.

The common ejaculatory ducts being in the posterior part of the gland usually escape injury during the enucleation.

4. During and after the operation the bladder is irrigated with hot water through the catheter in the urethra. This procedure generally suffices to check hæmorrhage; if not, the prostatic bed must be packed with gauze soaked in a solution of adrenalin.

5. Suprapubic drainage is provided." The wound usually closes within a month. In order to prevent a urethral stricture forming opposite the apex of the prostate, a catheter, or bougie, is occasionally passed during the healing stage.

Mention the Chief Dangers of the Operation.

After operation death may result from:—

- (a) Acute suppurative nephritis.
- (b) Cystitis.
- (c) Pelvic cellulitis through injury to the space of Retzius.
- (d) Septic absorption from the prostatic bed.
- (e) Septic embolism.
- (f) Reactionary hæmorrhage.

Describe Perineal Prostatectomy.

The perineal route is adopted for small fibrous prostates and in malignant disease. Young's operation will be described. With the patient in the exaggerated lithotomy position, make a Λ -shaped incision with the apex over the central part of the perineum and the limbs extending into the ischio-rectal fossæ.

STEPS.—1. After dividing the skin and fæcia, secure the superficial perineal vessels.

2. Open up the ischio-rectal fossa on each side.

3. Cut the bulbo-cavernosus muscles from the central point of the perineum and pull them forwards along with the bulb and the transversus perinei.

4. Divide the recto-urethralis muscle, thus entering the space of Denonvillier, and displace the rectum backwards.

5. Introduce a grooved staff into the urethra and divide the compressor urethræ and membranous urethra on it.

6. Replace the staff by Young's prostatic "tractor." Gently pull the handle downwards and upwards, thus displacing the prostate nearer to the surface.

7. By blunt dissection, working on the posterior surface of the prostate, separate this organ from the rectum. Be very careful not to injure the latter.

8. The posterior surface of the prostate is incised and the enlarged masses or the lateral lobes removed. In addition to the finger and a dissector, curved scissors will be necessary.

9. After attending to hæmorrhage, pack the lateral cavities with gauze and introduce a couple of drainage tubes into the bladder through the incision in the membranous urethra.

10. Unite with catgut the levator ani muscles which have been divided from the rectum.

11. Close the wound except where the tubes and gauze emerge. The patient is usually out of bed on the second or third day.

THE EXTERNAL GENITALS.

Describe the Lymphatic Drainage of the External Genitals.

(a) PENIS.—The superficial lymphatics drain into the glands of the inguinal region ; the deep lymphatics into the inguinal and external iliac glands.

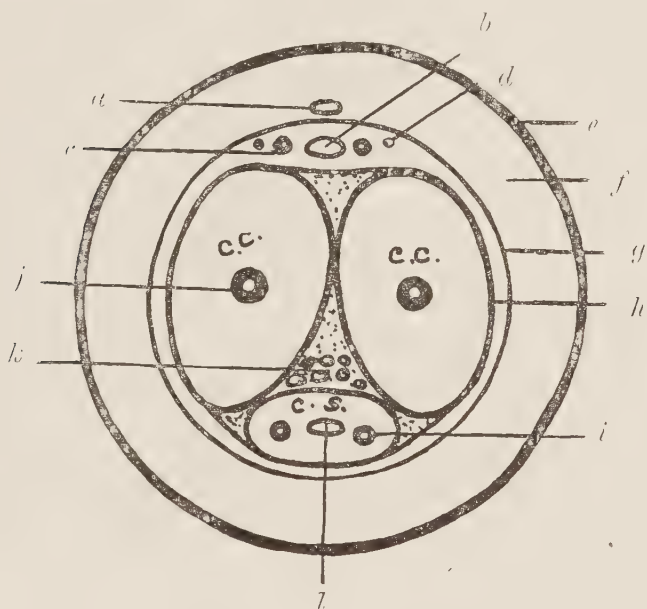
(b) SCROTUM.—Drain into the inguinal glands.

(c) TESTES.—Accompany the internal spermatic vessels and open into the lumbar chain of glands.

How is Circumcision performed?

After carefully sterilising the parts and administering an anæsthetic, draw the prepuce gently forwards with forceps, and apply a clamp between the forceps and the glans. Amputate the skin on the distal side of the clamp and remove the latter; secure all bleeding vessels. Cautiously

Fig 48.—TRANSVERSE SECTION OF PENIS.



- a. Superficial Dorsal Vein.
- b. Deep Dorsal Vein.
- c. Dorsal Artery.
- d. Dorsal Nerve.
- e. Skin.
- f. Superficial Fascia and Dartos.
- c.c. Corpora Cavernosa.

- g. Fibrous Sheath.
- h. Tunica Albuginea.
- i. Artery accompanying Urethra.
- j. Artery to Corpus Cavernosum.
- k. Septal Vessels.
- l. Urethra.
- c.s. Corpus Spongiosum.

separate the so-called mucous membrane from the glans, cutting it away with scissors. Unite the skin and "mucous membrane" with interrupted sutures and dress the wound. In adults ten grains of potassium bromide should be administered at night-time for four days.

Describe Partial Amputation of the Penis.

This operation is indicated in the early stages of carcinoma

Operative Surgery, Part III.

involving the prepuce or glans. After thoroughly sterilising the penis, the anterior portion of the organ is wrapped in gauze and an elastic band fixed around the base of the penis to act as a tourniquet.

An antero-lateral flap is outlined whose length is equal to half the circumference of the body of the penis. The extremity of the flap must be well clear of the diseased area. A *short* posterior skin flap must also be cut.

STEPS.—1. Dissect up the flaps.

2. Introduce a bougie in order to protect the urethra.

3. Insert a knife transversely between the corpora cavernosa and the corpus spongiosum dividing the former at the required level.

4. Remove the bougie and sever the corpus spongiosum a little further forwards.

5. Ligate the main vessels.

6. Separate the urethra and bring it out through a hole in the centre of the dorsal flap.

7. Split the end of the urethra and unite it to the skin.

8. Suture up the skin flaps and remove the tourniquet.

9. After ten days dissect away the lymphatic glands of both inguinal regions.

Describe Complete Removal of the Penis.

The incision commences at the symphysis pubis, travels round each side of the root of the penis, splits the scrotum, and terminates at the central point of the perineum.

STEPS.—1. The two halves of the scrotum are separated and the testes held apart.

2. A bougie is introduced in order to identify the urethra.

3. The bulbo-cavernosus muscles are carefully freed from the triangular ligament, and the arteries to the bulb secured.

4. Withdraw the bougie and divide the urethra, one inch from the ligament.

5. With an elevator separate the ischio-cavernosus muscles and the crura from the ischio-pubic rami, and ligate the artery to the corpus cavernosum on each side ; in some cases the internal pudendal (pudic) arteries can be tied.

6. Secure the dorsal vessels and sever the suspensory ligament.

7. Split the urethra and stitch it to the skin in the posterior part of the wound.

8. Suture the wound after providing for drainage.

9. The lymphatic glands on both sides are removed ten days later.

Give the Surgical Treatment of Hypospadias.

This deformity consists in a deficiency of the floor of the spongy portion of the urethra. The varieties are :—

(a) *Balanic* { With a groove on the under surface of the
glans.
No groove on the under surface of the glans.

(b) *Penile*.

(c) *Complete*.

In the *balanic* form the deficiency affects the glans only ; in the *penile* form both the glans and the body of the penis ; while in the *complete* variety the scrotum is cleft and the urethra opens on the perineum. Only two operations are described here—one for the balanic variety when a groove is present, and one of the penile form.

How is Balanic Hypospadias treated ?

Make two incisions in the long axis of the penis flanking the groove. The incisions should be parallel with each other and extend deeply into the glans (fig. 49). Lay a glass rod in the groove and suture the lower edges of the wound over it. As healing occurs the epithelium lining the

original groove grows over the raw surface surrounding the rod.

Describe the Operation for Penile Hypospadias.

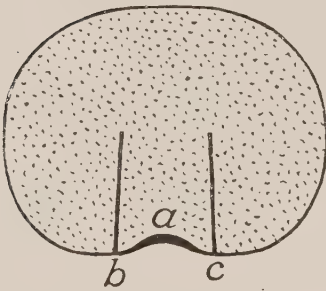
In this deformity the penis is usually curved downwards and it is necessary to straighten the organ before attempting to rectify the urethral defect.

Make a small horizontal incision through the fibrous adhesions, straighten out the penis and stitch up the wound longitudinally. Strap the penis to the abdominal wall, and wait six months. At the end of this period, if balanic

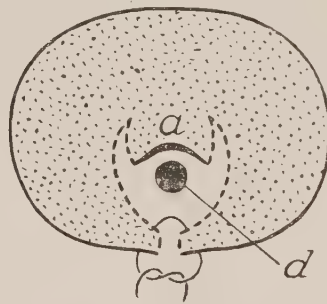
Fig. 49.—OPERATION FOR BALANIC HYPOSPADIAS.

(Glans in Transverse Section).

First Step.



Second Step.



a. Epithelial Groove.

b. and *c.* Incisions.

d. Rod.

The dotted lines are raw surfaces.

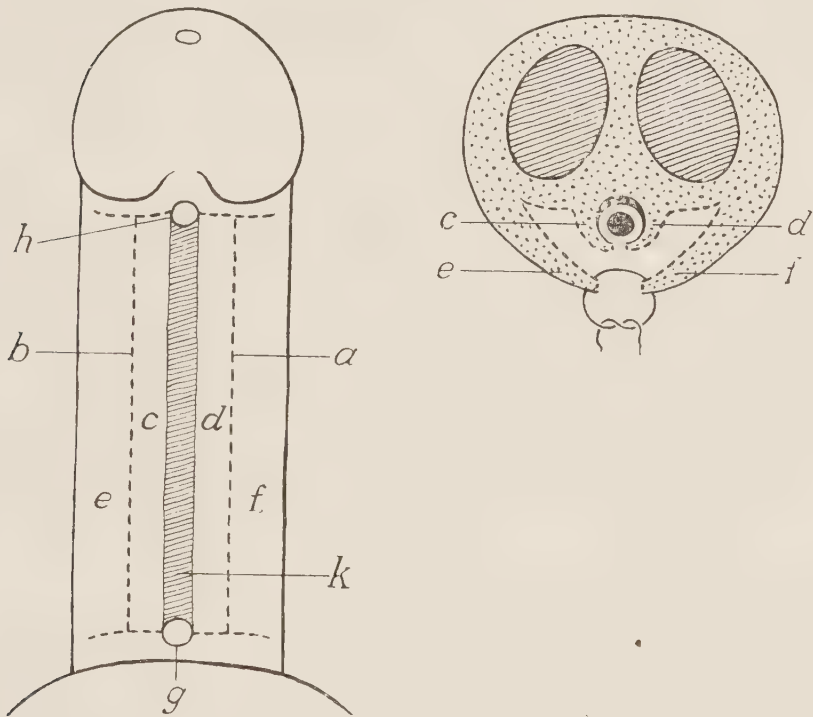
hypospadias exists, deal with this, and when healing has occurred, operate upon the cleft in the penile urethra. The operation about to be described is termed Duplay's method (fig. 50).

From the glans to the opening of the urethra (*a* and *b*) make a longitudinal incision on each side of the urethral groove. The incisions are parallel and reach down to the corpora cavernosa. From the extremities of these incisions carry two short cuts at right angles (*c* and *d*). Dissect up the flaps. Now make two larger flaps (*e* and *f*) of the same length with their bases on the lateral aspects of the penis. Introduce a glass rod into the median groove and draw the small flaps beneath it. Lastly suture the large flaps

over the small ones. Close the gap between the balanic and the new penile urethra.

Until healing occurs, drain the bladder by means of a suction apparatus, the catheter passing through the original urethral opening, and attach the penis to the abdominal wall. At a subsequent period the original urethral orifice is closed by a flap taken from the perineo-scrotal junction.

Fig. 50.—DUPLAY'S METHOD.



h. Posterior Opening of Balanic Urethra. *k.* Epithelial Groove.

The rest of the lettering is explained in the text. The dotted lines in the right hand diagram represent raw surfaces.

Supra-pubic instead of urethral drainage may be adopted, in which case the old urethral orifice can be cauterised; this often obviates any plastic operation.

Give the Steps of Syme's Operation for Urethral Stricture.

Syme's staff is required for this operation (external urethrotomy), which is undertaken for permeable callous strictures.

The anterior half of the instrument is slender and grooved, but the posterior half is of full size; the junction of the two parts is termed the shoulder. Pass the staff until the shoulder rests firmly against the face of the stricture: the slender portion passes through the stricture into the bladder. Place the patient in the lithotomy position. An assistant holds the staff with his right hand, and draws up the scrotum with his left.

STEPS—1. Make an incision about two inches long in the middle line of the perineum, from above downwards. Continue the dissection until the shoulder of the staff can be distinguished.

2. Enter the point of the knife into the groove of the staff, at the posterior part of the wound, about an inch below the shoulder, and cut *upwards* through the stricture. If the stricture is completely divided, the broad part of the staff can be passed through it.

2. A full-sized rubber catheter is passed from the meatus into the bladder.

4. Any sinuses or fistulæ present should be split up and packed with iodoform worsted.

5. If there are no such septic complications, stitch up the urethral wound in three layers.

Describe Wheelhouse's Operation for Urethral Stricture.

This operation is used when the stricture is an impermeable one. Introduce Wheelhouse's staff, the groove being directed towards the surgeon, and the hook away from him. Place the patient in the lithotomy position, the assistant holding the staff and the scrotum as in Syme's operation.

STEPS.—1. Incise down to the urethra upon the groove; rotate the staff until the hook catches in the upper angle of the wound.

2. With artery forceps hold the lateral margins of the urethral wound aside.

3. Examine the face of the stricture with a probe-pointed director and endeavour to locate the opening.

4. Pass the director through the opening of the stricture and divide the stricture upon the director *from before backwards*.

The subsequent treatment is similar to that in Syme's operation.

What are the Constituents of the Spermatic Cord?

The spermatic cord consists of a collection of blood vessels, nerves, lymphatic trunks and the vas deferens, united by connective tissue. There are three coverings, these being from within outwards (a) infundibuliform fascia—from the fascia transversalis, (b) cremasteric fascia—from the internal oblique, and (c) intercolumnar fascia—from the external oblique.

The anterior part of the cord comprises the internal spermatic artery, the cremasteric artery and the spermatic veins or pampiniform plexus, while the posterior part is formed by the vas deferens and its vessels. The nerves in the cord are the genital branch of the genito-femoral and sympathetic filaments.

Describe the Operative Treatment of Varicocele.

This operation is performed when (a) the patient desires to enter the public services or to reside abroad; or (b) marked pain is present; or (c) the patient is suffering from sexual hypochondria.

Make a transverse or slightly oblique incision one inch long over the external (subcutaneous) abdominal ring. Divide the superficial structures, intercolumnar fascia, cremasteric fascia and infundibuliform fascia, thus exposing the cord. Apply gentle upward traction to the cord and withdraw it from the wound. Separate the enlarged spermatic veins from the vas and its vessels. *Be careful not to injure the latter or atrophy of the testis will result.*

Apply two strong catgut ligatures about one and a half inches apart, and remove the intervening plexus. It is impossible to preserve the internal spermatic artery. Tie the ends of the two ligatures together. Suture the wound and dress. Support the scrotum for three weeks.

What are the Indications for Excision of the Testis?

- (a) Carcinoma and lymphosarcoma.
- (b) Advanced tubercular disease.
- (c) Certain cases of syphilitic disease.
- (d) Certain cases of incomplete descent.
- (e) Trauma.

Describe the Operation.

Make an incision similar, but slightly longer, to that for varicocele.

STEPS.—1. Divide the superficial tissues, intercolumnar, cremasteric and infundibuliform fasciæ.

2. By applying traction to the cord, carefully withdraw the testis from its bed.

3. Ligature the constituents of the cord, and remove the testis.

4. In malignant or tubercular disease enlarge the incision in an upward and outward direction, and isolate, and remove the vas as far as the deep (internal) abdominal ring. The further treatment is the same as that following the operation for varicocele. At a later period the lumbar lymphatic glands on the corresponding side should be excised.

The above operation requires considerable modification when the scrotum is involved in the disease.

Describe a Radical Operation for Chronic Hydrocele.

An incision is made similar to that described for excision of the testis. The same structures are encountered, and cautiously divided, until the bulging upper pole of the tunica vaginalis presents. Evacuate the contents by means of a trocar and cannula. Enlarge the opening, and by pressure upon the scrotum displace the testis through the wound. The effect of this manœuvre is that the tunica vaginalis is reversed, *i.e.* the inner or testicular layer faces the scrotum. Pass a single suture through the cut edges of the tunica vaginalis, and replace it and the testis into the

scrotum. Close the skin wound and apply a dressing. The scrotum must be elevated for some days after the operation.

THE STOMACH.

Mention the Chief Relations of the Stomach.

Visceral.—The stomach occupies the “stomach-chamber” of the abdominal cavity, an area bounded above by the left lobe of the liver and the left cupola of the diaphragm. In front are found the anterior abdominal wall and the ribs. (*Note.*—When the stomach is empty the transverse colon forms an immediate anterior relation.) Behind and below are the following:—the left suprarenal, upper pole of left kidney, spleen and splenic artery, pancreas, left crus of diaphragm, transverse meso-colon and transverse colon.

Peritoneal.—With the exception of a small area, the stomach is completely covered with peritoneum. This “bare area,” triangular in shape and about two inches wide, is found on the inferior surface, a little below and to the left of the cardia. It is in contact with the diaphragm. The stomach intervenes between the great sac and the lesser sac (bursa omentalis) of peritoneum. The peritoneal connections are the:—

- (a) Gastro-hepatic ligament to the lesser curvature.
- (b) Gastro-colic and gastro-lienal ligaments to the greater curvature.
- (c) Gastro-phrenic ligament from the posterior aspect of the stomach, along the left side of the œsophagus, to the diaphragm.

Give the Vascular Supply and the Lymphatic Drainage.

The main bloodvessels are found along the lesser and greater curvatures, and therefore more or less parallel with the long axis of the stomach. The branches from these vessels pass over the gastric surface at right angles to the long axis. Two arteries are associated with the lesser curvature, namely, the left gastric (coronary) of the cœliac axis

and the right gastric (pyloric) a branch of the hepatic. Coursing along the greater curvature are the right gastro-epiploic of the gastro-duodenal and the left gastro-epiploic, a branch of the splenic. The fundus is supplied by the short gastric arteries (*vasa brevia*) which spring from the splenic. The veins accompanying the arteries terminate in the portal system. Mayo has called attention to two veins, superior and inferior, running over the anterior surface of the pylorus at the pyloro-duodenal junction. They lie almost in the same vertical plane.

Closely connected with the chief bloodvessels are the lymphatic glands, the lymph ultimately draining into the celiac nodes. The gastric glands can be classified thus—

| | | | | | | |
|-----------------|---|---|---|--|---|-------------------------|
| Gastric glands. | { | <i>Superior</i> (i.e. along lesser curvature) | { | Paracardial Right gastric. Left gastric. | { | Right. Left. |
| | | <i>Inferior.</i> (i.e. along greater curvature). | | Gastro-epiploic. Subpyloric. | | Anterior. Posterior. |

What Operations are performed upon the Stomach?

- (a) *Gastrotomy*—Opening the stomach.
- (b) *Gastrostomy*—Making a permanent opening into the stomach for feeding purposes.
- (c) *Gastropexy*—Fixing a displaced stomach by tightening up the gastro-hepatic ligament.
- (d) *Gastrectomy* — { Partial } Removal of a part or the
 { Complete } whole of the stomach.
- (e) *Gastroplication*—Lessening the size of a dilated stomach.
- (f) *Pyloroplasty*—Widening a narrow pylorus.
- (g) *Gastro-gastrostomy*—Anastomosis of the two compartments of a “hour-glass” stomach.
- (h) *Gastro-jejunosomy*—Making a communication between the stomach and the jejunum.

Give the Indications for Gastrotomy.

1. For the removal of foreign bodies from either the stomach or the lower end of the œsophagus.
2. Exposing an ulcer on the posterior wall of the stomach.
3. Dilating the pylorus (Loreta's operation)—an operation rarely done at the present time.
4. Occasionally for gastric hæmorrhage.

What are the Steps of the Operation?

The incision commences at the costal margin and passes vertically downwards over the left rectus muscle for four or five inches.

STEPS.—1. Divide the skin, fasciæ, and anterior layer of the sheath of the rectus; displace the muscle outwards; divide the posterior layer of the sheath, fascia transversalis, and parietal peritoneum.

2. Identify the stomach, a necessary proceeding as the transverse colon may present. The stomach is darker in colour, has no appendices epiploicæ, and its peristaltic waves pass from left to right. Withdraw the stomach as far as possible from the wound.

3. Pack off the peritoneal cavity and incise the anterior wall at right angles to its long axis, thus avoiding the branches of the gastric vessels.

4. Deal with the condition present.

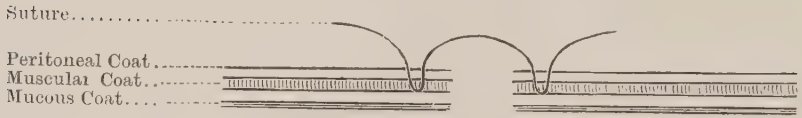
5. Close the gastric opening by two layers of sutures, the first ones are of catgut or fine silk, and include all the coats; while the second are of fine silk and only include the seromuscular tunics—Lembert suture (fig. 51).

Fig. 51.—LEMBERT'S SUTURE—SURFACE VIEW.



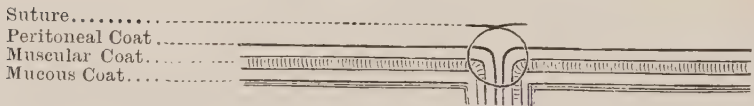
For the sake of clearness, only two stitches are figured.

Fig. 52.—LEMBERT'S SUTURE—SIDE VIEW.



Notice that the suture does not go through the mucous coat.

Fig. 53.—LEMBERT'S SUTURE TIGHTENED.



Observe how the edges are inverted, and the peritoneal surfaces opposed, when the suture is tightened.

6. Suture the peritoneum, posterior layer of sheath of rectus, anterior layer of sheath of rectus and skin separately.

Describe Gastrostomy.

This operation is performed for carcinoma of the œsophagus. Several methods have been devised; that of Witzel will be described. The incision and dissection resemble those used in gastrotomy.

STEPS.—1. Identify the stomach and withdraw a small portion of the anterior wall near the cardiac end.

2. With a continuous Lembert stitch unite the withdrawn portion to the peritoneum, fascia transversalis, and posterior layer of the sheath of the rectus.

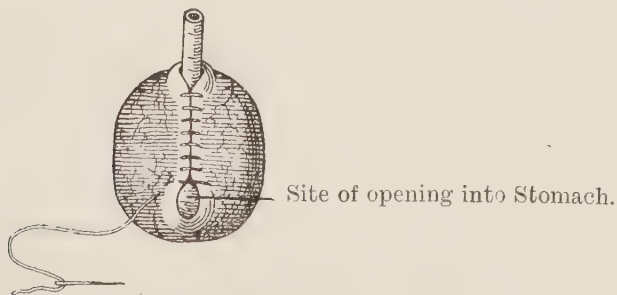
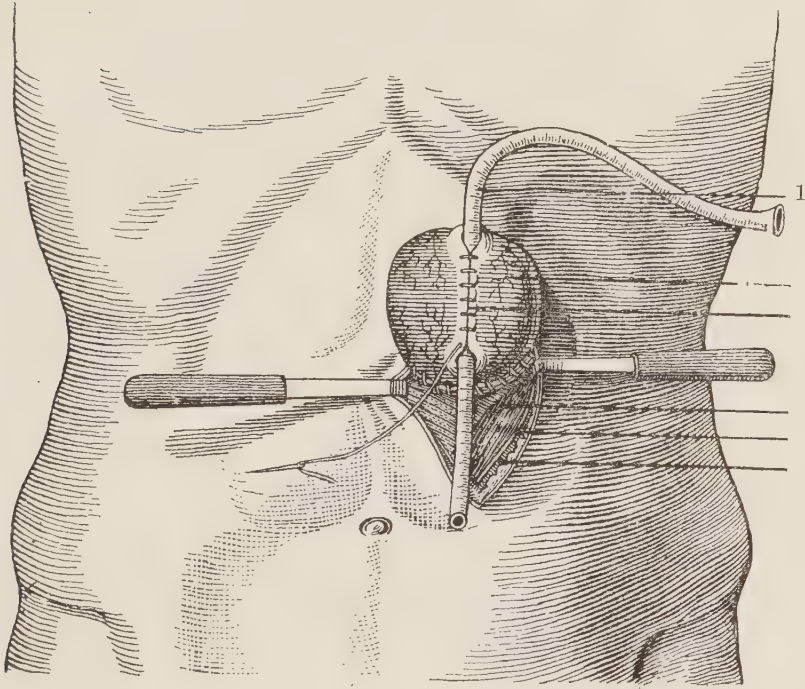
3. Take a piece of rubber tubing about the size of a No. 12 catheter and lay it on the surface of the exposed gastric area. It should be applied in the long axis of the stomach.

4. With a continuous Lembert stitch unite the anterior wall over the tubing for about one and half inches.

5. Make an opening in the lower end of the canal which has been formed and introduce the tube into the stomach (fig. 54).

6. Continue the Lembert stitch over the gastric opening.

Fig. 54.—GASTROSTOMY—THE FORMATION OF THE CANAL.
(After KOCHER.)



Shows end of Tube pushed into Stomach.

- | | |
|----------------------------|--|
| 1. Rubber Tube. | 4. Sheath of Rectus (posterior layer). |
| 2. Stomach. | 5. Left Rectus Muscle. |
| 3. Canal partially formed. | 6. Sheath of Rectus (anterior layer). |

7. Bring the upper end of the tubing out through the skin wound, and close the rest of the wound. If

sepsis is feared a small drainage tube may be inserted for a few days.

8. The patient should be fed through the tube before leaving the operating theatre. Eight ounces of sterilised peptonised milk with white of egg can be given.

Describe Pyloroplasty.

This operation consists in widening any constriction of the pylorus of non-malignant origin.

After shutting off the operation "area" with gauze, an incision, two inches long, is made through the anterior gastric wall, in the long axis of the organ, and the resulting aperture sutured at right angles to this. Two tiers of sutures are employed, the first passing through all the coats, and the second being of the Lembert type, *i.e.* sero-muscular. An omental graft is then stitched over the line of suture.

Give the Steps of Partial Gastrectomy.

Undertaken for malignant disease of the pyloric segment of the stomach, partial gastrectomy is only carried out after inspection and examination of the affected area. The presence of numerous adhesions, or evidence of involvement of the liver or peritoneum, would contra-indicate the operation; the surgeon in these cases contenting himself with gastro-jejunostomy.

The usual gastric incision and dissection are employed until the stomach is exposed and examined.

STEPS.—1. Perform posterior gastro-jejunostomy, a healthy portion of the stomach being united to the jejunum.

2. Make an entero-anastomosis between the two limbs of the jejunal loop.

3. After cautiously separating any adhesions, withdraw the diseased segment of the stomach out of the wound and pack off the neighbourhood with gauze pads.

4. Through a small aperture in the gastro-colic ligament introduce two gastric clamps, side by side. They include the body of the stomach and emerge through an aperture which has been made in the gastro-hepatic liga-

ment. These should always be applied about one and a half inches on the cardiac side of the edge of the tumour.

5. Carefully divide the gastro-hepatic ligament from the affected area, ligating the left gastric (coronary) and right gastric (pyloric) vessels.

6. Deal with the gastro-colic ligament in a similar manner securing the gastro-epiploic vessels.

7. Pack gauze behind the stomach and divide the organ between the clamps. Wrap the pyloric segment in gauze and displace it to the right.

8. Close the divided cardiac portion by (*a*) a mattress suture about half an inch away from the cut margins ; (*b*) a continuous suture through all the coats at the lines of section ; and (*c*) a row of Lembert sutures.

9. Apply two clamps side by side to the first part of the duodenum, about one inch beyond the pylorus. Divide the bowel between the clamps.

10. In removing the duodenal part of the growth, remember the three structures passing behind the first part, namely, from left to right, portal vein, gastro-duodenal artery, and the common bile duct.

11. Close the duodenum by (*a*) a continuous suture through all the coats at the line of section ; and (*b*) burying this by one or more purse-string sero-muscular sutures.

12. If possible stitch the gastro-colic ligament over the duodenal stump.

13. Close the abdomen in the usual manner.

What is Kocher's Method ?

After resecting the diseased area, the stomach is closed, and the duodenum joined to the posterior gastric wall by an end-to-side anastomosis ; the first row of stitches secures all the coats, while the second row is of the Lembert type.

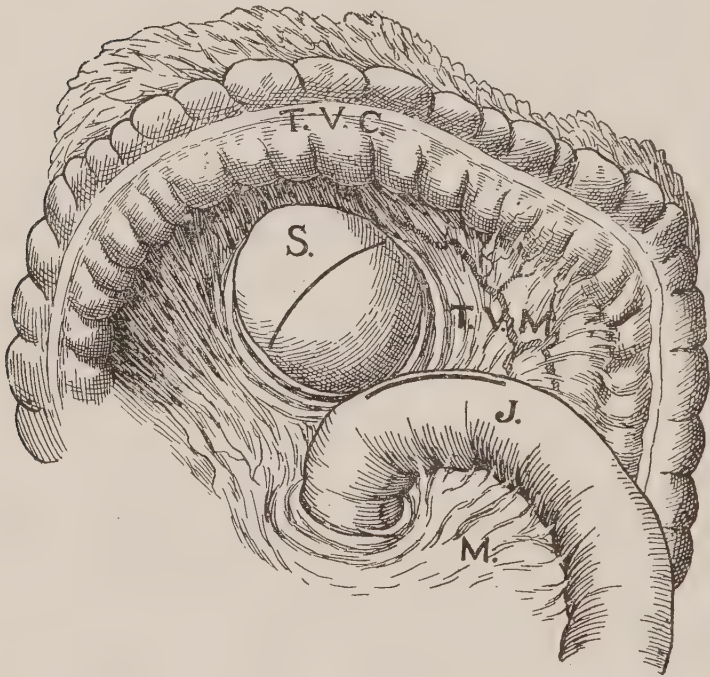
Describe Posterior Gastro-jejunostomy.

This operation is most commonly performed for chronic gastric or duodenal ulcers, and for pyloric stenosis. If

possible, the stomach should be washed out previous to administering the anæsthetic. Open the abdomen by a vertical incision four inches in length through the right rectus above the umbilicus. Palpate the appendix, gall-bladder, biliary passages, first and second parts of duodenum, head of pancreas, and the stomach, before proceeding to the anastomosis.

Fig. 55.—POSTERIOR GASTRO-JEJUNOSTOMY.

(After MAYO.)



T.V.C. Transverse Colon with Great Omentum, turned up.

S. Posterior wall of Stomach pulled through opening in

T.V.M. Transverse Meso-Colon.

J. Commencement of Jejunum, in position for application of clamp.

M. Mesentery.

N.B.—The dark lines on the Stomach and Jejunum indicate the position and direction of the future incisions.

STEPS.—1. Pull the gastro-colic ligament and the transverse colon upwards over the epigastrium so as to stretch the transverse meso-colon.

2. In the transverse meso-colon identify the arch formed by the left branch of the colica media artery.

Beneath this open the meso-colon, thus exposing the posterior surface of the stomach.

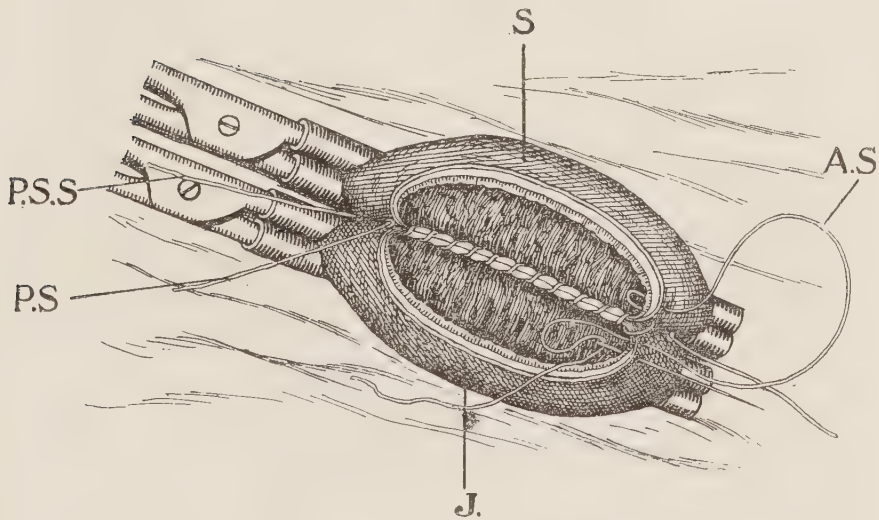
3. By the pressure of the assistant's fingers, the stomach is made to bulge through the opening. Recognise the pyloric antrum and apply a clamp.

4. Run the fingers along the attachment of the transverse meso-colon until the highest loop of the jejunum is found. Verify its nature by seeing that the upper end is fixed.

5. Secure three-quarters of the circumference of the gut as near its commencement as possible, and include about four inches of bowel in the clamp.

Fig. 56.—POSTERIOR GASTRO-JEJUNOSTOMY.

(After MAYO.)



S. Stomach. J. Jejunum. In both, the three coats are shown.

6. Approximate the two clamps so as to bring the stomach and jejunum into contact, and with gauze shut off the rest of the abdomen from the area of anastomosis.

7. Join the two viscera by a posterior sero-muscular silk stitch running from left to right.

8. Make a three inches incision in the long axis of the jejunum on the antimesenteric border, and an incision of similar length through the stomach *at right angles* to the long axis of the latter.

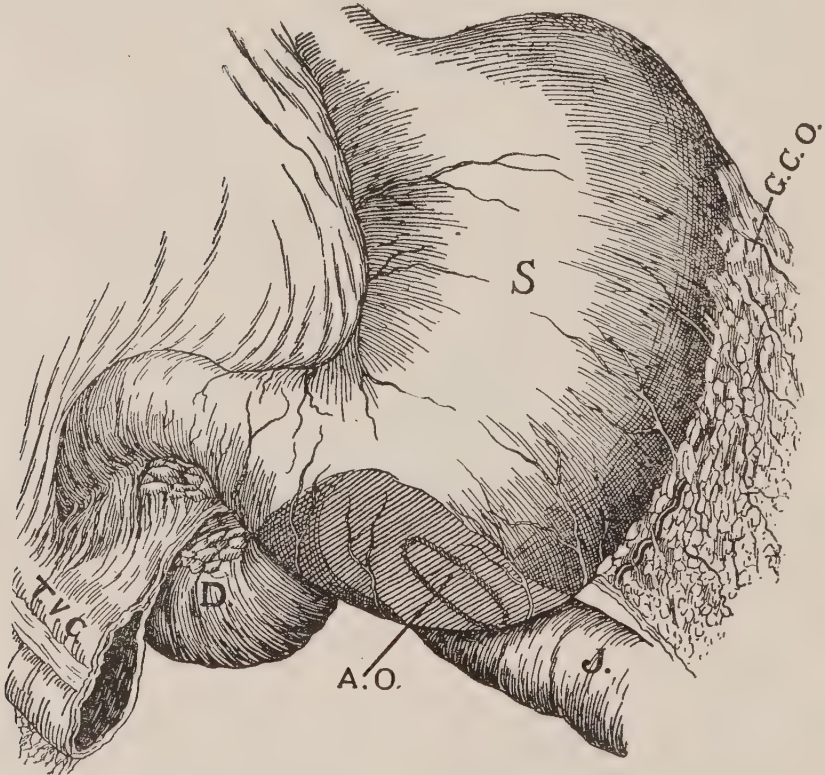
9. Commencing behind, unite the cut margins with a continuous stitch involving all the coats.

10. Carry the original Lembert stitch over the front and sides of the junction, and unite the edges of the aperture in the transverse meso-colon.

11. Sponge the viscera with warm saline and remove all gauze pads.

Fig. 57.—POSTERIOR GASTRO-JEJUNOSTOMY.

(After MAYO.)



S. Stomach.
G.C.O. Gastro-Colic Omentum
T.V.C. Transverse Colon.

D. Duodenum.
J. Jejunum.
A.O. Anastomotic Opening.

12. Return the viscera to the abdomen, closing the cavity in the usual manner.

What is Roux's Y-method?

The jejunum is divided about six inches beyond the duodeno-jejunal flexure, and the proximal end of the distal

segment united to the posterior surface of the stomach by end-to-side anastomosis. The distal end of the upper segment is joined to the lower segment of the jejunum.

THE SPLEEN.

Give the Main Points in the Surgical Anatomy of the Spleen.

The spleen is chiefly found in the left hypochondrium and the left epigastrium. The long axis of the organ is almost vertical in the erect position of the body, but when the patient is reclining, it practically coincides with that of the tenth rib. Completely surrounded by peritoneum, the spleen is fixed to adjacent viscera by two folds—(a) the gastro-lienal ligament containing the short gastric vessels, and (b) the lieno-renal ligament conveying the splenic artery and vein. The splenic vessels are frequently adherent to the tail of the pancreas.

RELATIONS. — *Diaphragmatic surface*.—Diaphragm and ninth, tenth, and eleventh ribs.

Renal surface—Left kidney.

Gastric surface—Stomach and tail of pancreas.

Basal surface—Splenic flexure of colon and phrenico-colic ligament.

Trace the Bloodvessels and Lymphatics.

The splenic artery arises from the coeliac axis and passes behind the omental bursa, along the upper margin of the body of the pancreas, in front of the left suprarenal and kidney, to reach the splenic hilum. In the latter part of its course it lies in the lieno-renal ligament. Before entering the spleen it divides into four or five branches. The issuing veins unite as a single trunk, which joins with the superior mesenteric to form the vena porta. The lymphatic vessels terminate in the glands near the hilum, and in the supra-pancreatic (pancreatico-splenic) nodes.

What are the Indications for the Operation of Splenectomy?

Splenectomy, or removal of the spleen, may be required for:—

- (a) Malaria.
- (b) Abscess.
- (c) Hydatid disease.
- (d) Lympho-sarcoma.
- (e) Severe trauma.
- (f) Tubercular disease.
- (g) Splenic anæmia.

Excision of the spleen is followed by a general enlargement of the lymphatic glands.

Describe the Operation.

An incision of three or four inches is made either in the left linea semilunaris, or in the middle of the left rectus, or in the mesial plane above the umbilicus.

STEPS.—1 Divide the integument, fasciæ, abdominal musculature, fascia transversalis, and parietal peritoneum.

2. Gently draw the stomach towards the right side, and the spleen comes into view.

3. Recognise the gastro-splenic ligament and divide it between two ligatures. This band of peritoneum contains the vasa brevia and left gastro-epiploic vessels.

4. Carefully withdraw the spleen from the abdominal cavity, the lower pole being “delivered” first. If the organ is in a condition of perisplenitis removal will be difficult.

5. Secure the splenic pedicle; this is formed by the lieno-renal ligament, and transmits the splenic vessels. The artery will be found at a slightly higher level than the vein. The vessels consist of several divisions; each must be ligated separately.

6. Be careful not to injure the tail of the pancreas, which is implanted into the gastric surface of the spleen, and avoid damage to the splenic flexure of the colon.

7. Close the wound, and apply a large pad of gauze over the splenic area.

How is Splenopexy performed?

The two chief operations for fixing a movable spleen are (1) Rydygier's, and (2) Barbenheur's. The latter will be described. A vertical incision three or four inches long is made in the mid-axillary line from the tenth rib to the iliac crest, which is supplemented by a small horizontal incision at its upper end.

STEPS.—1. Divide the skin and fasciæ, external oblique, internal oblique, transversalis, fascia transversalis, and parietal peritoneum, the last only in the vicinity of the spleen.

2. Bring the spleen through the aperture made in the parietal peritoneum, and stitch the peritoneal margin to the splenic pedicle.

3. Transfix the lower pole of the viscus with a strong catcut stitch, and secure the stitch round the tenth rib.

4. Close up the abdominal wound.

INGUINAL HERNIA.*Describe the Abdominal Rings.*

(a) *The subcutaneous inguinal ring* (external abdominal), is a deficiency in the aponeurosis of the external oblique muscle. Triangular in shape, it is directed outwards and slightly upwards. The base is formed by the pubic crest, the outer pillar by the inguinal (Poupart's) ligament, and the inner pillar by that portion of the external oblique aponeurosis which is inserted into the symphysis and the pubic crest of the opposite side. The two pillars are retained in position by the intercolumnar fibres, which are prolonged upon the spermatic cord as the intercolumnar fascia. When palpated by invaginating the scrotum, a normal ring only admits the tip of the index finger; on dissection, however, the dimensions are:—

| | | | |
|-----------------|---|---|---------------------|
| Base of apex | . | . | 1 inch. |
| Breadth of base | . | . | $\frac{1}{2}$ inch. |

As the spermatic cord or round ligament issues from the inguinal canal, it rests upon the outer pillar.

- (b) *The abdominal inguinal ring* (internal abdominal) is an oval-shaped orifice in the fascia transversalis, through which the spermatic or round ligament enters the inguinal canal. The ring is situated half an inch above a point a little internal to the middle of the inguinal ligament. Remember that the inferior (deep) epigastric artery passes upwards immediately to the inner side of the ring. The margins of the opening are prolonged upon the cord as the infundibuliform fascia.

What are the Boundaries of the Inguinal Canal?

The length of the canal in the adult averages one and a half inches. It has an oblique direction running downwards, inwards, and slightly forwards.

BOUNDARIES.—*Anterior.*—Aponeurosis of the external oblique, and in the outer third of the canal, the internal oblique.

Posterior.—Conjoined tendon, triangular fascia, and fascia transversalis.

Superior.—Lower fibres of internal oblique and transversalis abdominis.

Inferior.—Abdominal aspect of inguinal and lacunar (Gimbernat's) ligament.

Describe Hesselbach's Triangle.

This triangular area intervenes between the inferior epigastric artery and the outer edge of the rectus abdominis. Its base is formed by the inner half of the inguinal ligament. The triangle is subdivided by the obliterated hypogastric artery, the inner half usually being the bigger. The floor of the inner portion is the conjoined tendon, whilst the fascia transversalis forms the floor of the outer half.

Mention the Chief Operations for Inguinal Hernia.

1. Macewan (described in *Catechism Surgery, Part V.*)
2. Bassini.

3. Kocher.
4. Halstead.
5. G. Chiene.

What are the Principles of a Radical Operation?

Two points have to be attended to, namely (a) the removal of the peritoneal sac of the hernia, and (b) the narrowing of the inguinal canal. The former is the more important proceeding, as except in elderly persons, or in old-standing cases, it is better to leave the canal alone.

Describe Bassini's Operation.

The incision lies parallel with the inner half of the inguinal (Poupart's) ligament, and about half an inch above it.

STEPS.—1. Divide the superficial structures and secure the superficial epigastric vessels.

2. Split the aponeurosis of the external oblique as far as the abdominal inguinal ring, and, if necessary, the horizontal fibres of the internal oblique.

3. Divide the cremasteric fascia.

4. By gauze dissection clear the sac as far as the abdominal ring, carefully holding the spermatic cord aside.

5. Cautiously open the sac and return the contents to the abdomen.

6. Transfix the neck of the sac with a catgut stitch, ligature the neck and remove the sac.

8. Replace the spermatic cord.

9. Suture the split external oblique aponeurosis.

10. Close the wound without drainage.

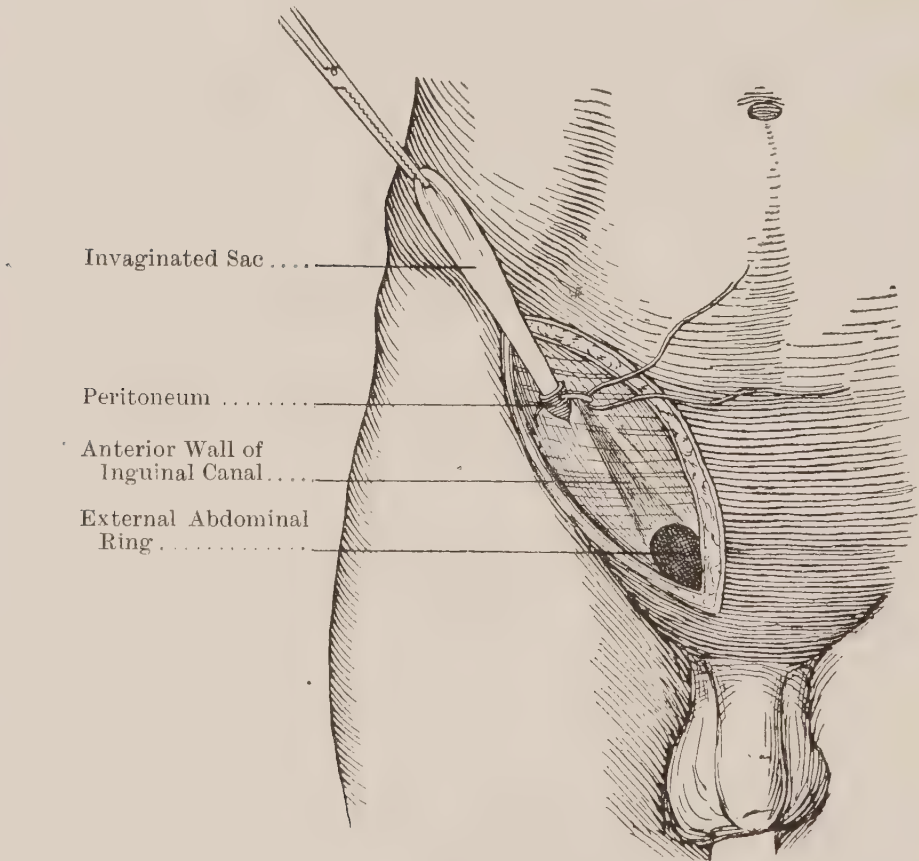
What is Halstead's Modification?

In order to diminish the diameter of the inguinal canal, Halstead resects the pampiniform plexus (internal spermatic veins). After suturing the posterior wall of the canal to the abdominal surface of the inguinal (Poupart's) ligament, he places the spermatic cord between the external oblique muscle and the skin.

Describe Kocher's Procedure.

After exposing and clearing the sac, its fundus is seized with toothed forceps and pushed up the inguinal canal so as to invaginate the sac. It is brought out through an aperture in the aponeurosis of the external oblique opposite the

Fig. 58.—RADICAL CURE OF INGUINAL HERNIA (KOCHER'S METHOD).
(After KOCHER.)



internal abdominal ring. Fix it by a catgut stitch and remove the excess of sac. Suture the aperture with catgut.

What is Chiene's Method?

The operation is applicable for uncomplicated herniæ in young adults and in children. Make a small oblique incision over the abdominal inguinal ring.

STEPS.—1. Secure the superficial epigastric vessels, and divide the aponeurosis of the external oblique

2. Identify the neck of the hernial sac and carefully isolate it from the spermatic cord.

3. Transfix the neck with a ligature, divide the sac and fix the neck to the anterior abdominal muscles.

4. Unite the divided external oblique by an overlapping suture and close the wound.

FEMORAL HERNIA.

Give the Surgical Anatomy of Femoral Hernia.

Femoral hernia protrudes through the femoral ring and femoral canal, reaching the surface by passing through the saphenous opening. At this spot the hernia abuts against the falciform edge, which frequently causes the swelling to alter its direction, and to mount up over the inguinal ligament. The sac of a femoral hernia, as it passes through the femoral ring, has important relations: (*a*) the inferior (deep) epigastric vessels lie above and external; (*b*) the femoral vein is separated merely by a septum of the sheath; and (*c*) the spermatic cord or round ligament is almost immediately over the sac. The “dangerous” variety of an abnormal obturator artery forms an internal relation.

Give the Coverings of a Femoral Hernia.

From the surface inwards, the coverings are:—

(*a*) Integument.

(*b*) Superficial fascia.

(*c*) Cribriform fascia.

(*d*) Anterior wall of femoral sheath, which is a prolongation of the fascia transversalis.

(*e*) Septum crurale.

(*f*) Extra-peritoneal fat.

(*g*) Peritoneum (sac).

Describe the Radical Operation for Femoral Hernia.

Make a slightly curved incision with the convexity downwards over the inguinal ligament. The incision is about two inches long.

STEPS.—1. Cautiously dissect through the coverings of the hernia until the sac is reached.

2. Displace the lower margin of the wound downwards, and separate the sac from its surroundings.

3. Open the sac and deal with its contents.

4. Secure the neck of the sac with a clamp, and cut off the remainder.

5. Pull the upper margin of the wound upwards, incise the aponeurosis of the external oblique, and divide the horizontal fibres of the internal oblique if necessary.

6. Isolate the neck of the sac, transfix it with a catgut stitch, draw it through the divided aponeurosis and stitch it there.

7. Suture the divided inguinal musculature.

8. It is not necessary to attempt to obliterate the femoral canal.

9. Close the wound.

What is Battle's Operation?

Make a vertical incision over the femoral canal. Dissect down until the sac reached.

STEPS.—1. Open the sac and deal with the contents.

2. Ligate the neck of the sac securely and remove the sac.

3. Now prolong the incision upwards and outwards over the subcutaneous (external) ring for about one and a half inches.

4. Split the external oblique aponeurosis so that two flaps or "shutters" are formed.

5. The upper or inner "shutter" is fixed by three separate stitches to Gimbernat's ligament, the sheath of the pectineus, and the inguinal ligament.

6. The lower or outer "shutter" is sutured to the flap so as to overlap it.

7. Close the wound.

UMBILICAL HERNIA.

Two operations for umbilical hernia in adults will be described, that of (a) Mayo, and (b) Pringle.

Give the Steps of Mayo's Operation.

Two horizontal semilunar skin incisions are made around the base of the hernia.

STEPS.—1. Deepen the incisions through the superficial fat until the aponeurotic abdominal wall is laid bare for three inches above and below the sac.

2. Open the neck of the sac and deal with the contents. Intestine is replaced into the abdominal cavity, while omentum is ligated and removed.

3. Remove the sac and the overlying fat and skin.

4. Divide the abdominal wall horizontally on each side of the umbilical orifice for an inch or two.

5. Loosen the peritoneum from the aponeurotic flaps thus formed and suture the peritoneum transversely.

6. By interrupted mattress sutures of strong celluloid linen, unite the aponeurotic flaps so that the lower one is pulled behind the upper one.

7. With a continuous suture, stitch the free margin of the upper flap to the surface of the lower flap.

8. Close the rest of the wound.

Describe Pringle's Method.

The incision in the abdominal wall is similar to that employed by Mayo, but is on a larger scale. Its transverse diameter varies from ten to sixteen inches.

STEPS.—1. Dissect down to the sac, open it, and deal with the contents as in the previous operation.

2. Remove the sac from the skin and fascia covering it.
3. Dissect two aponeurotic flaps off the anterior surface of the recti muscles.
4. Introduce, -but do not tie, two or three sutures through the peritoneum, posterior layer of sheath and the recti muscles, so as to approximate the two halves.
5. Suture the adjacent margins of the posterior layer of the sheath and the peritoneum.
6. Suture the adjacent margins of the recti muscles.
7. Tie the mattress stitches first introduced. The sutures in steps 4, 5, and 6 are introduced vertically.
8. Suture the lower aponeurotic flap behind the upper by single stitches.
9. Unite the free margin of the upper flap to the surface of the lower flap by single stitches.
10. Close the superficial wound.

LIVER, GALL-BLADDER, AND BILE-DUCTS.

What is the Operative Treatment for Rupture of the Liver?

A vertical incision in the middle line is made above the umbilicus. Endeavour to control the hæmorrhage temporarily by grasping the gastro-hepatic ligament between the finger and thumb, one of the digits being inserted into the foramen of Winslow (epiploic foramen).

Ligate any visible bleeding vessels, and suture the rent with thick catgut stitches.

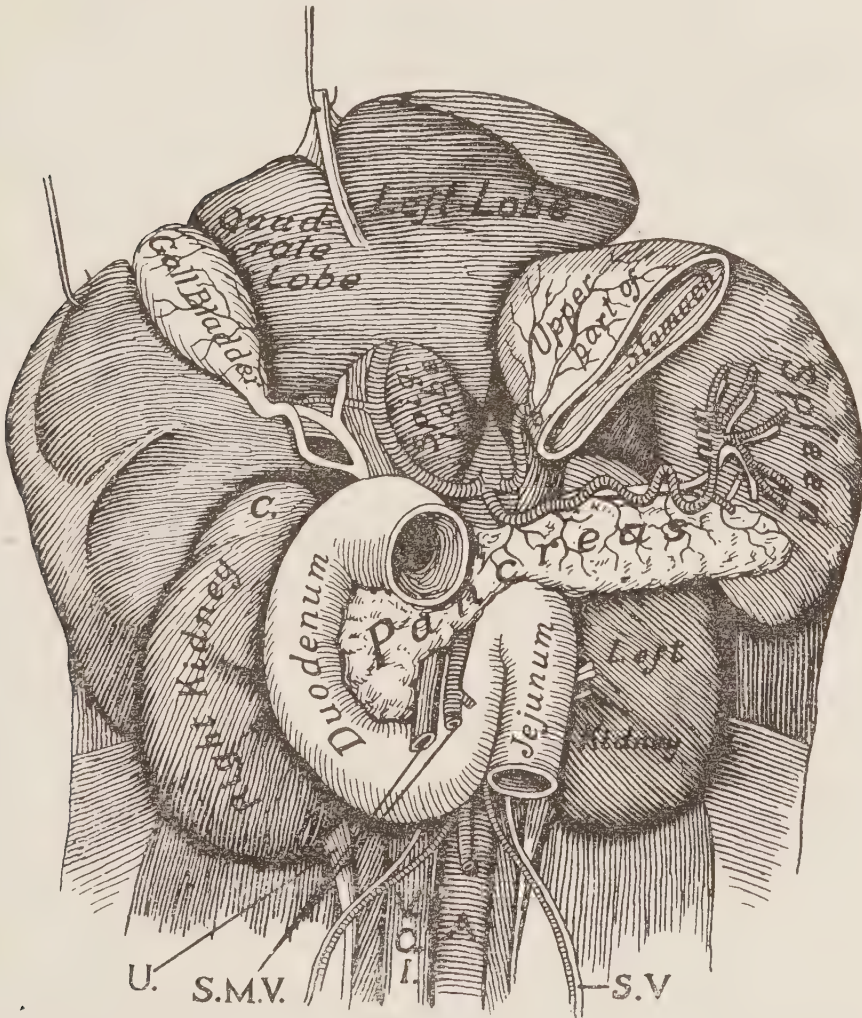
Describe Resection of the Liver for Tumour.

This operation is rarely called for, and usually involves excision of the gall-bladder in addition. A wedge-shaped area of hepatic tissue is removed, keeping wide of the diseased area. If adhesions are not too numerous, hæmorrhage may be controlled from the foramen of Winslow as in the previous operation. The liver can be divided with a Paquelin cautery. Tie all bleeding vessels and unite the cut surfaces by interrupted sutures of thick catgut.

Give the Operation for Hepatic Cirrhosis.

In hepatic cirrhosis considerable obstruction occurs to the portal circulation. This is partly relieved by the normal

Fig. 59.—DUODENUM AND ADJACENT VISCERA.
(After TESTUT.)



C. Supra-Renal Capsule.

A. Aorta.

Spig. Lobe. Spigelian Lobe of Liver.

V.C.I. Inferior Vena Cava.

S.V. Spermatic Vessels.

S.M.V. Superior Mesenteric Vessels.

U. Ureter.

anastomosis between the portal and systemic venous systems, namely:—

- (a) The accessory vein of Sappey and the superficial umbilical veins.

- (b) The gastric and œsophageal and phrenic veins.
- (c) The superior hæmorrhoidal, middle hæmorrhoidal, and inferior hæmorrhoidal veins.
- (d) The inferior mesenteric and left internal spermatic veins.

The Talma-Morrison operation provides an additional viscero-systemic anastomosis.

A mesial incision is made between the ensiform cartilage and the umbilicus.

STEPS.—1. The ascitic fluid is allowed to escape slowly, and the peritoneal and pelvic cavities dried with gauze.

2. The diaphragmatic surfaces of the liver and spleen are rubbed with gauze so as to promote the formation of adhesions.

3. The great omentum is introduced between the rectus muscle and the posterior layer of its sheath.

4. Provide for suprapubic drainage for a few days.

5. Close the abdominal wound.

Describe the Gall-Bladder.

In size, a normal adult gall-bladder is three inches long and has a capacity of one to one and a half ounces. The relations are:—

Superior—Liver.

Left—Pylorus.

Right—Hepatic flexure of colon.

Inferior—Transverse colon and first part of duodenum. It is nourished by the cystic artery, a branch of the right hepatic. On reaching the neck, the artery divides into an internal and an external branch; they run on each side of the viscus as far as the fundus. The cystic vein opens into the portal vein.

Trace the Common Bile Duct.

Formed by the junction of the common hepatic and cystic ducts, the common bile duct extends to the second part of the duodenum. Three and a quarter inches long, the duct is divided into four parts:—(a) supra-duodenal, (b) retro-duodenal, (c) pancreatic, and (d) interstitial. The duct runs

along the right free margin of the gastro-hepatic ligament, in front of the epiploic foramen, accompanied by the hepatic artery and portal vein. From right to left the order is:—duct, vein, and artery. After passing behind the first part of the duodenum, it burrows through the posterior aspect of the head of the pancreas, and after descending behind the second part of the duodenum, unites with the main pancreatic duct to form Vater's ampulla. The latter opens on the summit of a small papilla in the second part of the duodenum.

What are the Chief Operations performed on the Gall-Bladder and Bile Ducts?

CHOLECYSTOTOMY.—Opening of the gall-bladder.

CHOLECYSTOSTOMY.—Opening and draining the gall-bladder.

CHOLECYSTECTOMY.—Removal of the gall-bladder.

CYSTICOTOMY.—Opening the cystic duct.

CHOLEDOCHOTOMY.—Opening the common bile duct. { for the removal of a calculus.

CHOLECYSTENTEROSTOMY.—Anastomosis of the gall-bladder and bowel.

Give the Main Indications for Cholecystotomy.

(a) Removal of calculi.

(b) Preparatory to cholecystostomy for

1. Cholecystitis.

2. Cholangitis.

3. Mucocele.

4. Drainage in malignant disease.

5. Drainage in biliary stasis.

6. Drainage in chronic pancreatitis associated with lithiasis.

What are the Common Incisions employed?

(a) Kocher.—An oblique incision one inch below and parallel to the costal margin.

(b) Mayo Robson.—A vertical incision about three inches long, through the right rectus. It may be prolonged upwards and inwards if necessary.

- (c) Oblique.—From the costal margin, in the angle between the outer edge of the rectus and the ninth costal cartilage, downwards and inwards towards the umbilicus.

In each case a sandbag, or narrow air-pillow, is placed beneath the patient's back, so as to widen the costal angle, and also to displace the biliary structures nearer to the surface.

Describe Cholecystostomy.

One of the incisions described in the previous question is made.

STEPS.—1. The anterior layer of the sheath of the rectus is divided; the muscle displaced or split; and the posterior layer of the sheath together with the fascia transversalis incised.

2. Open the parietal peritoneum and identify the gall-bladder; often the great omentum is adherent to it; in such cases separate the adhesions very gently.

3. The assistant now draws the free margin of the liver upwards and inwards. By this manoeuvre the bile ducts are straightened and rendered more accessible.

4. Carefully palpate the gall-bladder and bile ducts in order to locate any calculi present.

5. Place a large gauze pad over the right kidney area, another over the intestines, and often a third one over the stomach.

6. Pack around the fundus of the gall-bladder, or draw it through an opening in a sheet of dental rubber. Aspirate the gall-bladder, being careful not to soil the peritoneum.

7. Incise the wall of the gall-bladder; secure all bleeding vessels and introduce the finger. Remove any calculi either with a scoop or the finger. If the stone is firmly impacted, perform cholecystectomy.

8. Introduce a probe into the ducts to make sure that they are patent.

9. Push a thick-walled rubber drain into the gall-bladder for two inches, fix it there by two superimposed purse-string sutures of catgut, and bring the tube out

through the dressing into a bottle. Drainage is usually required for ten to fourteen days.

What are the Indications for Cholecystectomy?

- (a) Chronic cholecystitis when the gall-bladder is too small to drain.
- (b) Very acute cholecystitis.
- (c) Gangrene.
- (d) Malignant disease.
- (e) Calcification.
- (f) Perforating ulcers.
- (g) Stenosis of the cystic duct.
- (h) Empyema of the gall-bladder.

Give the Steps of the Operation.

An incision is made similar to that employed in cholecystostomy, and the gall-bladder exposed.

STEPS.—1. All adhesions must be carefully broken down.

2. Trace the gall-bladder backwards to the cystic duct. Divide the latter between two pairs of forceps and secure the cystic vessels.

3. Displace the gall-bladder from its bed by blunt dissection, working from behind forwards.

4. Divide the peritoneum on each side about half an inch external to the gall-bladder.

5. Suture the cut peritoneal edges so as to cover the raw hepatic surface left after removal of the gall-bladder.

6. If drainage is required, pass a rubber tube into the common hepatic duct, and fix it there with a purse-string suture.

7. If biliary drainage is not required, pass a cigarette drain down to the stump of the cystic duct.

Should the Gall-Bladder be aspirated before removal?

This is not necessary unless—

- 1. The gall-bladder is so distended that it might burst during manipulation, or

2. Any doubt exists as to the patency of the common bile duct.

By what Methods may the Common Bile Duct be opened?

- (a) Supra-duodenal choledochotomy.
- (b) Retro-duodenal choledochotomy.
- (c) Trans-duodenal choledochotomy.

Describe the Supra-duodenal Operation.

The biliary passages are exposed as before and gauze pads introduced as in the previous operation. After cautiously separating any adhesions, the duct is palpated as far as possible until the calculus is located. Incise the duct in its long axis directly over the stone. After removing the stone explore the duct with a probe so as to make sure that no further calculi are present. Introduce a drainage tube into the common hepatic duct, fix it with a catgut stitch, and suture the rest of the incision in the duct. Bring the drainage tube out at the lower part of the wound and leave for ten days.

How is the Retro-duodenal Choledochotomy performed?

After exposing the duodenum the second part is mobilised by dividing the peritoneum along its right margin and displacing the gut towards the left. The stone is located, and the duct opened over it. When the stone has been extracted, pass a probe along the whole length of the duct. Drainage is necessary after the operation.

Describe Trans-duodenal Choledochotomy.

Expose the duodenum as in the retro-duodenal operation.

STEPS.—1. Make a vertical incision in the middle of the anterior wall of the second part.

2. Palpate the duct through the posterior wall until the calculus is located.

3. If the stone is impacted in the ampulla of Vater, slit up the bile papilla and extract the stone.

4. If the stone lies above the ampulla, incise the posterior wall of the duodenum and the duct vertically, and remove the stone. The superior pancreaticoduodenal artery may be divided.

5. Suture the cut margins of the duct to the corresponding margins of the incision in the posterior duodenal wall.

6. Close the incision in the anterior wall by two tiers of suture, the first including all the coats, and the second being sero-muscular only.

Describe Cholecystenterostomy.

The gall-bladder is anastomosed to the bowel in cases of permanent obstruction to the common bile-duct. If the gall-bladder is distended it should be aspirated previous to the anastomosis. The duodenum if possible is selected; when however, adhesions render this impracticable, a coil of jejunum is brought to the gall-bladder. The junction is affected in a manner similar to that described in gastro-jejuno-stomy.

THE PANCREAS.

What are the Chief Relations of the Pancreas?

HEAD.—*Anterior*.—Transverse colon, origin of portal vein, and the superior mesenteric vessels.

Posterior.—Inferior vena cava, aorta, and common bile-duct. This portion of the gland wanders over the second and third parts of the duodenum for a variable distance.

NECK.—*Anterior*.—Pylorus.

Posterior.—Commencement of portal vein.

BODY.—*Superior*.—Stomach and splenic artery.

Posterior.—Aorta, origin of superior mesenteric artery, splenic vein, left suprarenal, and left kidney.

Inferior.—Transverse meso-colon, duodeno-jejunal flexure, small intestine, and transverse colon.

TAIL. — Gastric surface of spleen.

Give the Blood-vessels and Lymphatics.

The arterial supply is derived from the (a) superior pancreatico-duodenal of the gastro-duodenal; (b) inferior pancreatico-duodenal from the superior mesenteric; and (c) twigs from the splenic. The superior pancreatico-duodenal runs in front of the head, the inferior pancreatico-duodenal along the back of the head, while the two vessels anastomose along the lower margin of the head. The lymphatics terminate in the following nodes—left gastric, subpyloric, mesenteric and suprapancreatic.

How is the Pancreas exposed in Operations?

In acute or sub-acute pancreatitis, a mesial incision is made above the umbilicus; for pancreatic cysts, a vertical incision is made over the most prominent part of the swelling.

Pancreatitis.—Identify the gastro-colic ligament; incise the anterior layer just below the stomach avoiding any prominent blood-vessels. The bursa omentalis (lesser sac) has now been entered (fig. 60). As the posterior layer is often adherent to the pancreas in inflammatory conditions of that organ, the surrounding area should be shut off with gauze before incision. Incise the posterior layer and remove all hæmorrhagic and necrotic tissues. Pack the resulting cavity with gauze. When pus is present, drain either through the abdominal wound or by the lumbar route. In the latter case the counter opening is made in the costo-vertebral angle, *i.e.* on the outer side of the erector spinæ immediately below the last rib.

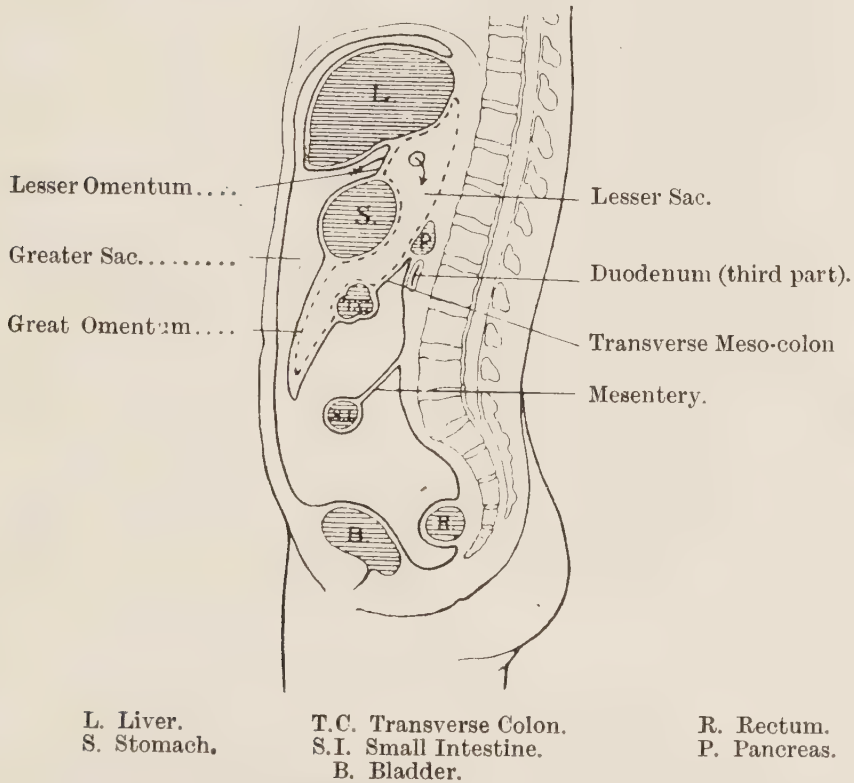
Pancreatic Cysts.—Cysts may occur—

- (a) Between the stomach and liver.
- (b) Between the stomach and transverse colon—the commonest site.
- (c) Behind the transverse colon,

In the first case the gastro-hepatic ligament will require incising; in the last two cases, the gastro-colic ligament (omentum). When the cyst has been

exposed, its wall should be sutured to the parietal peritoneum, and the contents removed with a trocar and cannula. Occasionally cysts in the tail of the pancreas can be excised. Drain the cyst by an incision in the left costo-vertebral angle.

Fig. 60.—VERTICAL SECTION OF PERITONEUM (Diagrammatic).



The arrow indicates the position of the foramen of Winslow (epiploic foramen).

THE VERMIFORM APPENDIX.

Describe the Vermiform Appendix.

Arising from the postero-internal surface of the cæcum, its origin is represented upon the surface of the body by Lanz's point, *i.e.* the junction of the right and middle thirds of a line connecting the anterior superior iliac spines. The appendix averages three and a half inches in length, and possesses a so-called mesentery, which does not, however, reach the apex. The appendicular vessels (from the ileo-

colic branch of the superior mesenteric) run between the two layers of this mesentery. The apex of the appendix most commonly assumes one of three positions (*a*) retro-cæcal, (*b*) pelvic, or (*c*) retro-iliac, passing upwards and to the left behind the last few inches of the ileum. Surgically, the readiest means of identifying the appendix is to find the cæcum, and trace its anterior longitudinal band downwards.

Mention the Peritoneal Fossæ in the Region of the Cæcum.

The more constant fossæ are the (*a*) retro-cæcal; (*b*) ileo-cæcal, and (*c*) ileo-colic. The ileo-cæcal is found in the recess between the lower margin of the ileum and the cæcum; it is limited anteriorly by "the bloodless fold of Treves," and behind by the meso-appendix. Its orifice is directed towards the left. The ileo-colic fossa lies in the angle between the upper margin of the ileum and the commencement of the ascending colon; it is bounded in front by the ileo-colic fold containing the anterior cæcal artery, and behind by the enteric mesentery. The mouth also points towards the left.

It is important to remember that the greater part of the vermiform appendix may be lodged within one of the cæcal fossæ.

What Incisions are employed for exposing the Appendix?

- (*a*) *Battle*.—The incision runs parallel with the linea semilunaris, half way between the umbilicus and the right anterior superior iliac spine.
- (*b*) *M'Burney*.—The incision bisects the junction of the right and middle thirds of a line joining the umbilicus to the anterior superior iliac spine.
- (*c*) *Lanz*.—An incision running inwards and slightly downwards over Lanz's point (*see* previous question).

In operations (*b*) and (*c*), the abdominal muscles are divided in the line of their fibres, the "girdiron" method, whereas in Battle's incision, the sheath of the rectus is opened and the muscles displaced inwards. The inferior (deep) epigastric vessels must be avoided.

Describe Appendicectomy.

The abdomen is opened by one of the incisions described, the cæcum exposed and the appendix searched for. It may be surrounded by adhesions which must be cautiously divided after packing off the adjacent part of the peritoneal cavity.

STEPS.—1. The appendix and the greater part of the cæcum are drawn out of the wound.

2. Clamp the meso-appendix with a pair of Kocher's artery forceps. Ligate the appendicular vessels, and divide the meso-appendix.

3. Secure the base of the appendix with a pair of artery forceps.

4. Remove the appendix on the distal side of the forceps.

5. Smear the distal end of the stump with pure carbolic acid, invaginate, and bury with a purse-string suture.

6. After carefully wiping the cæcum with gauze, replace it in the abdominal cavity.

7. Close the abdominal wound in the usual way. No drainage is required unless an exudate has collected; in such cases the pouch of Douglas is drained supra-pubically, and it may be necessary to pass another tube down to the apex of the cæcum.

Describe Appendicostomy.

Irrigation of the large bowel by means of an opening in the appendix is carried out for chronic colitis, dysentery, and fæcal stasis.

M'Burney's incision is made, the abdomen opened, and the appendix identified.

STEPS.—1. Draw the appendix out of the wound and anchor its base to the parietal peritoneum. A single silk stitch passed through the serous and muscular coats will suffice.

2. After an interval of three or four days, amputate the tip of the appendix, and introduce a No. 6 (English

scale) rubber catheter into the lumen. Fix it in position. Irrigation is carried out through the catheter. Treatment may be necessary for a few months.

The appendix is subsequently removed in the ordinary manner.

RECTUM AND ANAL CANAL.

Describe the Rectum.

The rectum extends from the third piece of the sacrum to a point one and a half inches beyond the apex of the coccyx. It differs from the pelvic colon in having neither sacculations, appendices epiploicæ, nor tænia coli. The upper third of the rectum is covered by peritoneum in front and laterally; the middle third only in front, while the lower third is entirely bare. At its upper part the lumen of the rectum is rather smaller than that of the pelvic colon, but a little above the anus the gut becomes dilated to form the ampulla.

The lateral flexures of the rectum produce the three valves of Houston seen in the interior; the usual arrangement being, the middle valve is on the right, and the superior and inferior valves on the left.

Give its Relations.

Anterior.—Recto-vesical pouch; base of bladder with seminal vesicles and vasa deferentia; posterior surface of prostate, and fascia of Denonvillier.

Posterior.—Sacrum and coccyx; levator ani muscles; ano-coccygeal body.

Laterally.—Pararectal fossæ and levatores ani.

What are the Rectal Stalks?

The second, third and fourth sacral nerves, together with the right and left branches of the superior hæmorrhoidal vessels are enclosed in a mass of condensed fibrous tissue which form the rectal stalks. The base of the stalks extends transversely along the front of the sacrum opposite the third or fourth segments.

Describe the Anal Canal.

The anal canal is an antero-posterior slit in the pelvic floor projecting downwards and backwards from the rectal ampulla to the perineum. It varies in length in adults from three quarters of an inch, to one and a quarter inches. On the mucous aspect the junction of the internal and external sphincters is marked by a slight elevation, the white line of Hilton. The columns of Morgagni are a series of vertical ridges (8-12 in number), each containing a twig from the superior hæmorrhoidal artery. In the upper part of the canal the mucous membrane between the columns forms the "anal valves."

Give the Lymphatic Drainage.

The ano-rectal glands are situated in the upper part of the rectum. They rest upon the external longitudinal fibres, and accompany the superior hæmorrhoidal vessels. Their efferents pass to the meso-colic nodes in the lower part of the pelvic meso-colon, which in turn open into the lumbar glands opposite the origin of the inferior mesenteric artery. The lower part of the anal canal drains into the inguinal glands.

Describe the Operative Treatment of Rectal Carcinoma.

For several days previous to operation, the bowels must be thoroughly emptied by purgatives and enemata. Forty-eight hours before the operation this treatment is stopped and the bowels allowed to rest. During the resting interval the patient is allowed no solid food.

There are three types of operation, depending upon the site of the tumour.

(a) LISFRANC.—The perineal route; the disease is restricted to the anal canal and rectal ampulla.

(b) KOCHER.—The coccygeal route; the ampulla is involved, but the anal canal is healthy.

(c) QUÉNU.—The abdomino-perineal route; the cancer is in the upper part of the rectum.

Quénu's method is the operation of choice, as it allows of

an examination of the liver, peritoneum, and pelvic viscera, and also permits of thorough removal of the lymphatic glands.

Give the Steps of the Perineal Operation.

The patient is placed in the exaggerated lithotomy position. The anus is closed by a purse-string suture. An incision is made from the central point of the perineum; it encircles the anus and passes in the middle line as far as the coccyx.

STEPS.—1. In front, divide the external sphincter from the central point; laterally, open up the fat in the ischio-rectal fossæ and secure the inferior hæmorrhoidal vessels; behind, detach the external sphincter and ano-coccygeal fascia from the coccyx.

2. Divide the recto-urethralis and levatores ani muscles.

3. In order to protect the bulbus urether in the subsequent dissection, introduce a metal sound into the bladder.

4. Dissect the anal canal and rectal ampulla from its surroundings; it is likely to be adherent to the prostate.

5. Tie the middle hæmorrhoidal vessels.

6. Define the upper limits of the growth, and apply two clamps to the rectum, one and a half inches above the growth.

7. Divide the bowel between the clamps with a thermo-cautery.

8. Remove the lower portion of the bowl.

9. Unite the cut margins of the levatores ani to the free edge of the upper portion, and suture this to the perianal skin.

Describe Kocher's Operation.

Either the exaggerated lithotomy or the right semiprone position is adopted. The anus is closed by a subcuticular circular suture. Commence the incision one inch behind the anus, and carry it in the middle line to the centre of the sacrum.

STEPS. 1. Separate the external sphincter and the ano-coccygeal fascia from their attachments to the coccyx.

2. Cut the coccygeal fibres of the sacrosciatic ligaments.

3. Secure the middle sacral artery as high up as possible, then remove the coccyx with bone pliers.

4. Pinch up and divide the rectal layer of pelvic fascia.

5. Open up the left pararectal peritoneal fossa, and separate the peritoneum from the anterior surface of the bowl.

6. Tie the middle hæmorrhoidal vessels.

7. Pull the rectum down until the rectal stalks can be divided between ligatures.

8. By blunt dissection, separate the rectum from the prostate, bladder, seminal vesicles, and vasa deferentia.

9. Apply two clamps, one and a half inches above the upper limit of the disease, and divide the bowel with a thermo-cautery between clamps.

10. Free the bowel down to the anal canal, and divide it between clamps.

11. If the pelvic colon is sufficiently mobile, it should be brought down and sutured to the healthy anal canal. There must be no tension, or gangrene may result.

12. Two rows of sutures are inserted including all the coats.

13. Pack the wound, drain, and remove the sub-cuticular anal stitch. If it is impossible to effect an end-to-end anastomosis, the lower end of the pelvic colon should be fixed to the skin at the posterior extremity of the wound, thus making a sacral anus.

Describe the Abdomino-perineal Operation (Quénu).

In weakly patients this operation can be performed in two stages with a few days interval between; the intra-peritoneal steps forming the first stage, and the perineal dissection the second stage. With the patient in the Trendelenburg position a mesial incision is made from just below the umbilicus to the pubes. If further room is

required, divide the left rectus transversely. After opening the abdomen, examine the pelvic viscera, peritoneum, and liver, to see if any secondary deposits are present. When these are absent, the radical operation is proceeded with.

STEPS.—1. Pack off the small intestines, and divide the pelvic colon between clamps at the level of the sacral promontory.

2. After closing the stump of the upper segment of bowel, it is brought out through an opening in the left iliac-fossa, and later converted into a permanent iliac anus.

3. Close the lower end of the gut and wrap it in gauze.

4. Tie the superior hæmorrhoidal vessels as they lie in the pelvic meso-colon.

5. Carry an incision through the peritoneum on each side of the lower segment of bowel, down to the floor of the pouch of Douglas. These incisions should be about three quarters of an inch lateral to the parietal attachment of the pelvic meso colon. On the left side the ureter must be carefully avoided.

6. Join the peritoneal incisions across the floor of Douglas's pouch.

7. Working with the fingers, carefully separate the colon with its glands and fat from the surrounding structures, ligating the middle sacral and middle hæmorrhoidal vessels as encountered; also divide the rectal stalks.

8. Cover the colon with pads of gauze and close the abdomen.

9. Place the patient in the lithotomy position, shut the anus as in Kocher's operation, and carry an incision from the central point of the perineum around each side of the anus, and backwards in the middle line to the lower part of the sacrum.

10. Deepen the incision, secure the inferior hæmorrhoidal vessels, separate the external sphincter, recto-urethralis, and ano-coccygeal fascia.

11. Divide the levatores ani and dissect the rectal ampulla from the bulb and prostate.

12. Withdraw the whole of the separated bowel through the perineal wound. Suture the wound except where a rubber drainage tube emerges.

13. The surgeon changes his gloves, reopens the abdomen, and sutures the peritoneal flap in position.

14. The abdominal wound is closed and the left iliac anus made.

How is the Operation modified when the Anal Canal is healthy?

The inferior mesenteric artery is reached through the meso-colon, and tied on the proximal side of the recto-sigmoidal arch. The healthy end of the pelvic colon is approximated to the lower part of the rectal ampulla. A rubber tube three quarters of an inch in diameter is thrust up the anal canal, and enters the colon for two or three inches. It is fixed there by a couple of catgut stitches. Draw down the pelvic colon and unite it to the remains of the ampulla by a series of interrupted catgut stitches. Pull upon the rubber tube until the pelvic colon is invaginated for about half an inch, then introduce a second row of stitches. Leave the tube *in situ*. It works loose in four or five days.

Describe the Anal Veins.

Near the anus the veins lie in the loose sub-mucous tissue between the muscular layer and the muco-cutaneous surface. From this spot they ascend in the columns of Morgagni to form a dense plexus in the lower part of the ampulla. The vessels issuing from the plexus penetrate the muscular wall to unite as the superior hæmorrhoidal vein. The perianal cutaneous veins are tributaries of the inferior hæmorrhoidal.

What are the Chief Operations used for Hæmorrhoids?

Hypertrophied tags of skin, ("dog ear") piles, are removed by snipping them off with scissors. In thrombotic external piles, an incision is made over the swelling and the clot removed. The common operations for internal hæmorrhoids

are (a) ligation, (b) excision, (c) clamp and cautery, and (d) removal of the pile-bearing area (Whitehead's operation).

Briefly describe the Methods of Ligation, Excision, and Clamp and Cautery.

In all these methods the patient is placed in the lithotomy position.

(a) **Ligation.**—Dilate the anal canal; seize each pile with crushing forceps and push it inwards towards the centre of the bowel. Snip through the mucous membrane of the base of the pile, pass a strong ligature round the groove and tie firmly. Ligate all the piles in a similar fashion, and cut away their distal portions. Dust the anal canal with iodoform, and introduce a $\frac{1}{4}$ grain morphia and bismuth suppository into the bowel. Apply a gauze dressing smeared with vaselin.

(b) **Excision.**—In this method after dilating the anal canal, the base of each pile is grasped with a pair of Kocher's artery forceps. Amputate the distal segment of the pile. Pass a continuous catgut ligature through the connective tissue round the base, and as it is tightened, the forceps are removed. The after treatment is the same as that mentioned above.

(c) **Clamp and Cautery.**—For very inflamed and friable piles. Gently pull down each pile with forceps, and apply the clamp to the base of the pile. Crush the pile by screwing up the clamp, and sear the redundant portion with the cautery heated to dull-red. The post-operative treatment is similar to that given in the preceding methods.

Give the Steps of Whitehead's Operation.

The main objections to this operation are (a) it is very severe owing to the profuse hæmorrhage, and (b) it is apt to be followed by stricture of the anal canal. The patient is placed in the lithotomy position and the anal canal dilated.

STEPS.—1. Divide the muco-cutaneous junction around half the circumference of the bowel, and by blunt dissection separate the varicose tissue.

2. Gradually draw down the detached mucosa, and divide the corresponding half transversely, immediately above the pile-bearing area.

3. Suture the free margins of the healthy mucosa to the anal margin, using interrupted chromic-gut stitches.

4. Carry out a similar procedure upon the remaining half of the circumference of the bowel.

Describe Ball's Operation for Inveterate Pruritus Ani.

Cleanse the parts and make a curved incision on each side of the affected area, "enclosing the entire ellipse with the exception of a narrow neck in front and behind." (Ball). Deepen the incisions until the sphincter ani externus is exposed. Loosen the flaps carefully from the muscles, and from the anal canal to just above the muco-cutaneous junction. Undercut the skin on the external, anterior, and posterior aspects for a quarter of an inch beyond the affected area. Attend to hæmostasis, and suture the flaps back again, leaving a few gaps for drainage.

INTESTINES.

Describe the Jejunum-ileum.

This portion of the intestinal canal is roughly twenty-two feet long, is freely movable, and decreases in size when traced downwards. Approximately the upper two-fifths of the tube is jejunum, the rest being ileum. When healthy it is possible to distinguish between the upper portion of the jejunum, and the lower part of the ileum; the jejunum is wider, darker, and feels thicker.

The jejunum-ileum is connected to the posterior wall of the abdominal cavity by the enteric mesentery, the latter extending in an oblique manner from the left side of the body of the second lumbar vertebra to the right iliac fossa. In the lower part of the ileum the mesentery is thicker, and contains more fat than in the jejunal area.

What is the Vascular Supply?

The vascular supply is derived from the vasa intestini tenuis of the superior mesenteric artery. About twenty branches spring from the convex border of the artery. Here after a variable distance they bifurcate, and then unite with each other to form a series of arterial arcades. From these latter fresh branches arise, which in turn form secondary arcades. In the lower part of the ileum, three or four arcades are present in the mesentery before the gut is reached, but the individual vessels are smaller than those found in the jejunum. The vasa recta arise from the terminal arcades, and pass alternately on each side of the wall of the bowel. Each branch is accompanied by a single companion vein.

How may two Portions of Bowel be anastomised?

1. Side-to-side (lateral).
2. End-to-side (termino-lateral).
3. End-to-end.

Describe Lateral Anastomosis.

STEPS.—1. After opening the abdomen, secure each of the two segments with a clamp, and bring them together.

2. Approximate the peritoneal surfaces with a continuous posterior stitch, leaving the suture upon the needle.

3. The bowel is opened with a narrow-bladed knife about one-third of an inch away from the suture-line.

4. With gauze gently remove any contents which escape.

5. Pass a continuous suture through all the coats (introduce the needle each time *from within outwards*) of both viscera. Commence the suture on the posterior surface, envelop the sides, and complete in front.

6. Continue the sero-muscular stitch around the sides and front.

7. Sponge the exposed viscera with saline, and remove the clamps.

8. Close the abdomen.

How is Murphy's Button used?

Murphy's button may be used for lateral anastomosis where haste is necessary. The male segment of the instrument is smaller than the female, and contains a spring.

STEPS.—1. The abdomen having been opened, approximate the two pieces of bowel it is desired to anastomose.

2. Introduce a purse-string suture through each on the anti-mesenteric surface.

3. Within the area of the suture make an incision at right angles to the long axis of the bowel.

4. Slip one of the segments of the button through each incision as far as the flange.

5. Tie the purse-string sutures.

6. Push the two halves of the button together.

7. The line of junction may be reinforced by a few Lembert stitches.

The button is passed per rectum in eight to ten days.

Give the Details of Termino-lateral Anastomosis.

An example of this variety of anastomosis occurs when the ileum is implanted into the pelvic colon in severe cases of colitis and dysentery. The abdomen is opened in the middle line below the umbilicus.

STEPS.—1. Search for, and identify the lower end of the ileum. A coil of it is chosen about fourteen inches above the ileo-cæcal valve.

2. Divide the bowel between two clamps.

3. Ligature the distal end and invaginate it with a purse-string suture.

4. Bring the descending limb of the pelvic colon out of the wound, and apply two clamps three inches apart.

5. Open the isolated portion of bowel through the anterior longitudinal band, and implant the proximal end of the divided ileum.

6. Unite the viscera by the two tiers of sutures described in lateral anastomosis.

What are the Indications for Enterectomy?

A portion of small intestine is removed for :—

- (a) Gangrene.
- (b) Malignant disease.
- (c) Multiple perforations.
- (d) Gun-shot injuries.
- (e) Tubercular strictures.

Describe the Operation.

After opening the abdomen, bring the affected segment out of the wound and pack it off.

STEPS.—1. Empty the contents by stripping the loop with the fingers.

2. Apply two crushing clamps above and below the disease. The clamps should be placed obliquely so as to include more of the anti-mesenteric than the mesenteric surface.

3. The mesentery is either divided piecemeal between artery forceps, or a V-shaped area may be excised.

4. Divide the bowel between the clamps; scissors may be employed for this.

5. End-to-end anastomosis can now be carried out.

Give the Steps of End-to-End Anastomosis.

1. Remove the clamps from the divided ends of the bowel, and wipe the edges with moist gauze.

2. The assistant approximates the divided portions.

3. Unite the two ends by a continuous suture, including all the coats. Commence the suture along the mesenteric surface. Gould applies a single mattress stitch first (fig. 65).

4. A continuous Lembert suture is now introduced around the whole circumference.

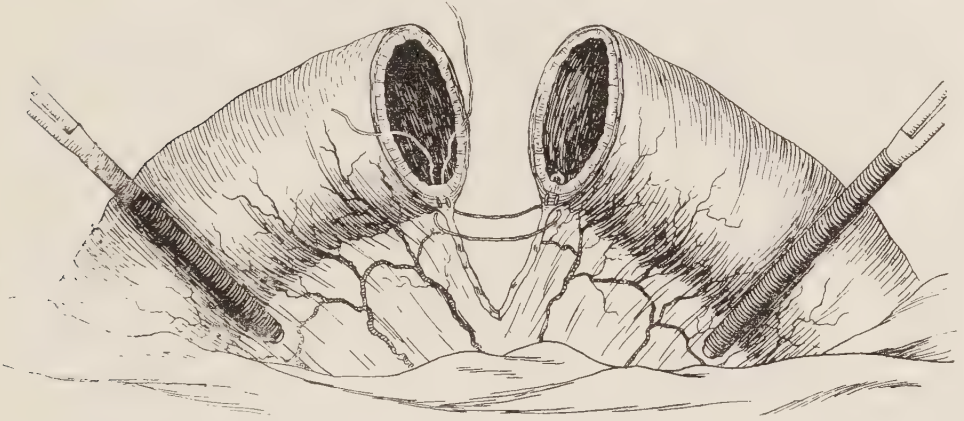
5. Join the divided edges of the mesentery by a few stitches.

6. Wipe the line of suture and close the abdomen.

Describe Jejunostomy.

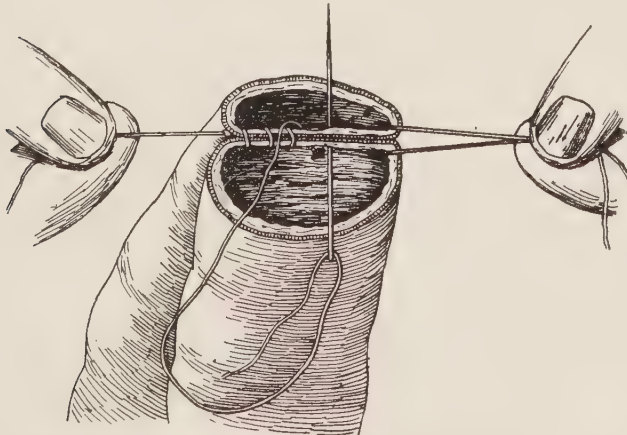
This operation is performed for feeding purposes in persons suffering from extensive gastric carcinoma. A

Fig. 61.—END TO END ANASTOMOSIS.
(After A. H. GOULD.)



Shows padded clamps applied. A V-shaped portion of mesentery has been excised along with the portion of intestine removed. Note method of introduction of special mattress stitch for bowel at edge of mesentery.

Fig. 62.—END TO END ANASTOMOSIS.
(After A. H. GOULD.)



Mesenteric portion of circumference being united by continuous stitch through all coats. Guides shown and also completion of the special mesenteric stitch begun on Fig. 65.

vertical supra-umbilical incision is made through the left rectus and the abdomen opened

STEPS.—1. Secure the highest loop of the jejunum, and bring it out of the wound.

2. Pack off the base of the loop, and make a good-sized lateral anastomosis between the two limbs.

3. Open the summit of the loop on its anti-mesenteric surface; the aperture should be large enough to admit a No. 10 rubber catheter (English scale).

4. Introduce the catheter into the distal (efferent) loop for about three inches, and fix it with a catgut stitch.

5. Invaginate the opening by two superimposed purse-string sutures.

6. Return the loop to the abdomen, sewing the apex to the parietal peritoneum and the posterior sheath of the rectus. The abdominal wound is closed except where the tube emerges. The patient can be fed immediately.

Give the Operative treatment of Acute Intussusception.

All means must be employed to combat shock. "Plenty of sutures should be threaded ready for immediate use, for every moment of time saved is of value, and the prognosis varies inversely with the length of time that the patient is upon the operating table" (Jacobson).

A vertical incision is made over the right rectus; it is about three inches long, with its centre three quarters of an inch below, and to the right, of the umbilicus. Open the abdomen in the usual manner. As the enteric mesentery is generally shortened, it is very difficult to bring the intussusception out of the wound. It is better, therefore, to perform the rest of the operation within the abdominal cavity.

If the intussusception is quite recent, it may be possible to reduce it by manipulation. The entering segment is steadied with one hand, and the sheath compressed with the other, until reduction is effected. *Do not pull upon the entering segment.* After reduction, close the wound, using continuous catgut sutures for the parietal peritoneum and the deeper fibres of the rectus, and interrupted fishing-gut sutures for the remaining layers.

What Complications may be present?

- (a) The entering segment may be gangrenous—in such cases resect the intussusception, close the cut ends of the bowel, and unite the two segments by a lateral anastomosis.
- (b) The invagination may be irreducible but not gangrenous—do not interfere with the invagination, but short-circuit the small and large intestine above and below the intussusception.
- (c) In delayed cases it may be necessary to resect the affected portion of bowel, and form an artificial anus.

Describe the Large Intestine.

The diameter of the large intestine decreases as it passes towards the anus. On external examination it differs from the small intestine in the following respects:—

- (a) The calibre is greater.
- (b) The longitudinal muscular fibres are arranged in three distant bands, the *tænia coli*, which produces a puckering of the large gut.
- (c) The presence of small peritoneal pouches containing fat, the appendices epiploicæ.

Internally Peyer's patches, villi, and *valvulæ conniventes* are absent.

What are the Relations of the Abdominal Portion of the Large Bowel?

1. *Cæcum*.—The cæcum occupies the right iliac fossa, lying immediately above the outer half of the inguinal ligament. It rests upon the ilio-psoas muscle. When distended, it is in contact with the great omentum and the anterior abdominal wall; when contracted, it is covered by a few coils of small intestine. Normally, the peritoneum entirely surrounds the cæcum.
2. *Ascending colon*.—From below upwards the ascending colon rests upon the iliacus, quadratus lumborum, and lower part of the right kidney. It is covered in front and at the sides by peritoneum; in exceptional cases an ascending meso-colon may be present.

3. *Hepatic flexure* is directed forwards and to the left in the right hypochondrium. It is in relation to the right lobe of the liver, the gall-bladder, and the lower part of the right kidney.
4. *Transverse colon*.—The transverse colon forms a loop projecting forward and downwards for a variable distance. The summit of the loop usually touches the anterior abdominal wall just above the umbilicus.
5. *Splenic flexure*.—Situated in the left hypochondrium, the splenic flexure is higher than the hepatic, and lies more deeply in the abdominal cavity. It is in relation to the tail of the pancreas and the basal surface of the spleen.
6. *Descending colon* extends to the iliac crest, where it becomes continuous with the iliac colon. In front are some coils of the small intestine, while behind are the left kidney, the angle between the psoas and quadratus lumborum, and lastly, the latter muscle itself. Peritoneum clothes the anterior and lateral surfaces; rarely a descending meso-colon is present.
7. *Iliac colon*.—In the great majority of cases no mesentery is found. The ilio-psoas muscle lies behind, and generally the small intestine in front. A distended iliac colon, however, is in contact with the anterior abdominal wall.

Describe Resection of the Ileo-Cæcal Portion of the Bowel?

This operation may be carried out for:—

- (a) Malignant disease of the cæcum.
- (b) Ileo-cæcal tuberculosis.
- (c) Actinomycosis of the cæcum.

An incision is made in the line of the fibres of the external oblique muscle, and the abdomen opened by the “gridiron” method.

STEPS.—1. If the omentum is adherent in the ileo-cæcal region, it must be cautiously separated between ligatures.

2. Retract the omentum and small intestines to the left side and pack them off.

3. Incise the parietal peritoneum along the outer edge of the ascending colon, and separate the colon together with the surrounding fat from its bed. Displace the bowel towards the middle line.

4. Identify the origin of the ileo-colic and colica dextra arteries from the superior mesenteric. Ligate these branches as high up as possible.

5. Secure the enteric mesentry of the terminal portion of the ileum (the last six inches usually suffices), and remove it between ligatures.

6. The termination of the ileum together with the cæcum and the lower part of the ascending colon, are withdrawn from the wound; pack them off from the peritoneal cavity.

7. Divide the withdrawn portions of the ileum and ascending colon between clamps in the usual manner.

8. Incise the peritoneum along the mesial edge of the ascending colon.

9. To complete the removal, close the colon as previously described, and insert the proximal end of the ileum into it by an end-to-side anastomosis.

10. Suture the peritoneum over the bare-area left on the posterior abdominal wall, and provide for drainage.

Give the Vascular Supply of the Large Bowel.

The arterial supply is furnished by the superior and inferior mesenterics of the abdominal aorta. The *superior mesenteric*—is directed in a curved manner, with the convexity towards the left as far as the right iliac fossa, where it terminates by anastomosing with its ileo-colic branch. The branches to the large bowel are—colica media, colica dextra, and ileo-colic. The media passes downwards and forwards in the transverse meso-colon to the transverse colon; it divides into a right and left branch, which anastomose with the dextra and sinistra (of the inferior mesenteric) respectively.

Directed towards the ascending colon, the dextra divides into two ascending, and descending, and anastomoses with the media and the ileo-colic. The ileo-colic runs downwards and to the right; its terminal branches are ascending and descending.

The *inferior mesenteric* arises from the aorta about one and a half inches above its bifurcation. It descends over the left psoas, and then over the left common iliac artery as the superior hæmorrhoidal. Its branches are colica sinistra, and two sigmoids, upper and lower. The sinistra passes towards the splenic flexure to anastomose with the media and the upper sigmoid. The sigmoid arteries anastomose with each other, and with the superior hæmorrhoidal, the trunk connecting the lower sigmoid to the superior hæmorrhoidal being termed the recto-sigmoidal arch.

Describe Resection of the Pelvic Colon.

The incision runs in the direction of the fibres of the external oblique. Open the abdomen by the "girdiron" method.

STEPS.—1. Separate the intestines, and expose the inferior mesenteric artery. Ligate the artery close to its origin.

2. Mobilise the lower part of the descending colon by incising the peritoneum vertically along its left margin.

3. Divide the middle of the descending colon between two clamps, and the pelvic colon in a similar manner two inches on the distal side of the tumour. The affected portion of the pelvic meso-colon is removed.

4. Divide the peritoneum piecemeal on the right margin of the descending colon, thus completing the resection.

5. End-to-end sutures can now be carried out, or alternatively, close up the two cut ends, and perform a lateral anastomosis.

6. The peritoneum is sutured over the "bare area" remaining on the posterior abdominal wall.

Drainage is required after the operation.

Give the Lymphatic Drainage of the Intestines.

The lymphatic glands of the small intestine are found in the enteric mesentery. There are three groups:—

(a) On the wall of the bowel.

(b) Accompanying the rami intestini tenuis.

- (c) A main set around the upper part of the superior mesenteric.

Four sets of glands are in relation to the colon :—

- (a) Epiploic, in the appendices epiploicæ.
- (b) Paracolic, along the inner margin of the ascending and descending colon, and the lower margin of the transverse colon.
- (c) Intermediate, around the branches of the colic arteries.
- (d) Main, on the ileo-colic, colica media, colica dextra, and colica sinistra vessels.

The lymph from the large bowel to the right of the middle of the transverse colon, drains into the glands along the upper part of the superior mesenteric, that from the remainder of the bowel passes to the glands on the inferior mesenteric.

The efferents from the superior mesenteric glands go to the intestinal trunk, which opens into the receptaculum chyli, while the inferior mesenteric glands drain into the left lumbar chain.

Describe Colopexy.

The operation of fixing the pelvic colon is performed for old-standing cases of complete prolapse of the rectum. Open the abdomen in the left inguinal region by the "gridiron" method, and identify the pelvic colon with its mesentery. After reducing the prolapse, sutures are introduced through a bloodless area of the meso-colon, and fixed to the deep part of the anterior abdominal wall.

What is Colostomy? Give the Indications for the Operation.

In colostomy an artificial anus, either of a temporary or permanent nature, is made in the large bowel usually in the iliac or pelvic colon. The chief indications are :—

- (a) In inoperable tumours of the large intestine.
- (b) In urgent cases of acute obstruction of the bowel.
- (c) Occasionally as a preliminary to excision of the rectum for carcinoma.
- (d) In certain cases of acute intussusception.
- (e) In Hirscheprung's disease of the colon.
- (f) In cases of imperforate anus.

Operative Surgery, Part III.



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